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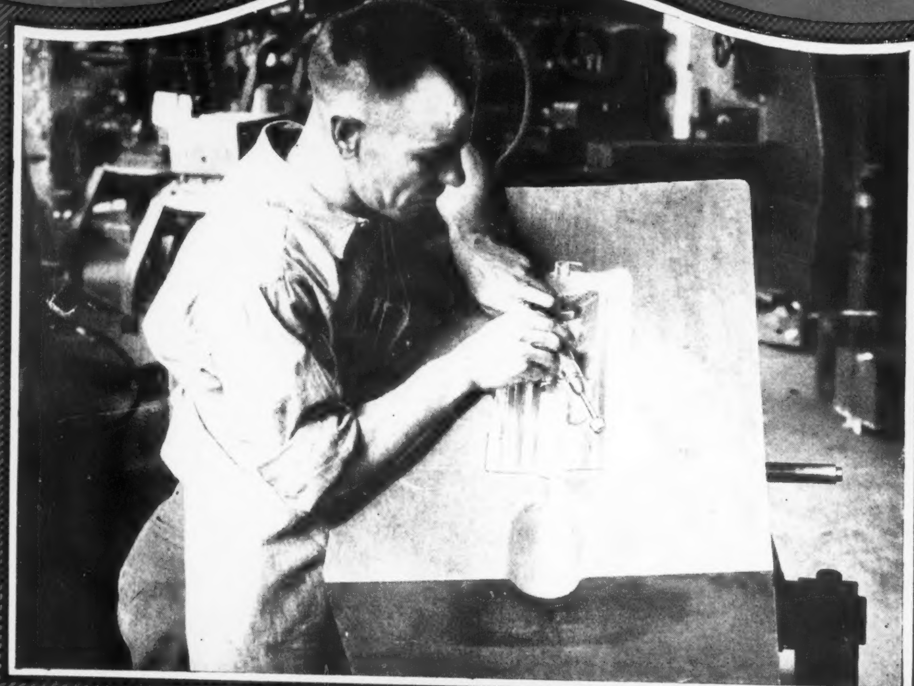

MODERN QUANTITY PRODUCTION CALLS FOR DIES FASHIONED FROM SOLID BLOCKS OF STEEL BY HIGHLY SKILLED WORKMEN

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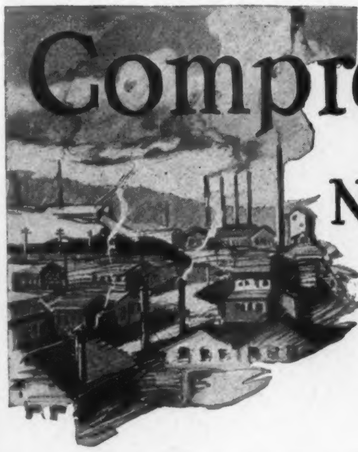

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Non-Metallic Minerals of Canada

The Dominion's Vast Resources of This Nature are Susceptible of Far Greater Development

By SIR STOPFORD BRUNTON*

> **MUCH as must yet be done to ascertain definitely the mineral resources of Canada, still enough has been done by the Government authorities and by enterprising prospectors to make it clear that the Dominion is wonderfully rich because of the extent and the character of her mineral deposits.**
>
> **Among these treasures of Nature's forming are varied non-metallic minerals for which the world has many and divers uses. In their way these non-metallic minerals are just as important to man as are the metallic minerals; and if some of these non-metallic minerals were lacking the modern world would be hard put to it to get along without them.**
>
> **In the years to come, Canada will inevitably play a big part in supplying these essential raw materials.**

WHEN one speaks of mining to the layman in Canada, some reference is usually made to the Hollinger Mine. Possibly, a man from the eastern townships may mention asbestos; one from Alberta or Nova Scotia may talk of coal; or silver may loom up in connection with Cobalt; but of the industry as a whole comparatively little is known.

The non-metallic minerals of the Dominion are just as important as the metallic ones, and this statement gives rise to the question: "What is the difference between metallic and non-metallic minerals?" The difference is not defined clearly by any single word or even by a short sentence in the English language, and can best be illustrated by citing examples. Gold, silver, iron, copper, lead, zinc, tin, etc., are metallic minerals, while coal, peat, gypsum, clay, salt, limestone, marble, granite, gem stones, and the like, are non-metallics.

The field of mining for non-metallics in Canada is so large that it cannot be adequately dealt with in a single article. Therefore, we will discuss only briefly some of the more important products. An attempt will also be made to show that mining is more closely associated with everyday life than is usually supposed. When the industrious housewife cleans her pots and pans with scouring soap, or polishes her knives with emery powder, little thought does she give to the things that make such cleanliness possible. Nevertheless, there is an industry for the production of such materials, which are known as abrasives. All abrasives are very similar in character; and the group consists of corundum—which in its pure form is represented by the ruby or the sapphire, emery, garnet, flint, quartz, and sand. The latter are used in the manufacture of sandpaper, emery paper, and emery wheels by means of which iron or steel articles can be made exact to within a ten-thousandth of an inch.

Sand and quartz are not so hard as emery or corundum and are mostly employed in the making of scouring soaps and cleaning powders. Sand blasting, too, affords a wide scope for the use of abrasives. Other abrasives, utilized only for the polishing of surfaces which must not be scratched, are tripolite and diatomaceous earth composed of spherical shells of minute organisms. Corundum is a somewhat uncommon mineral, and has been found, up to the present, only in certain counties in Ontario.

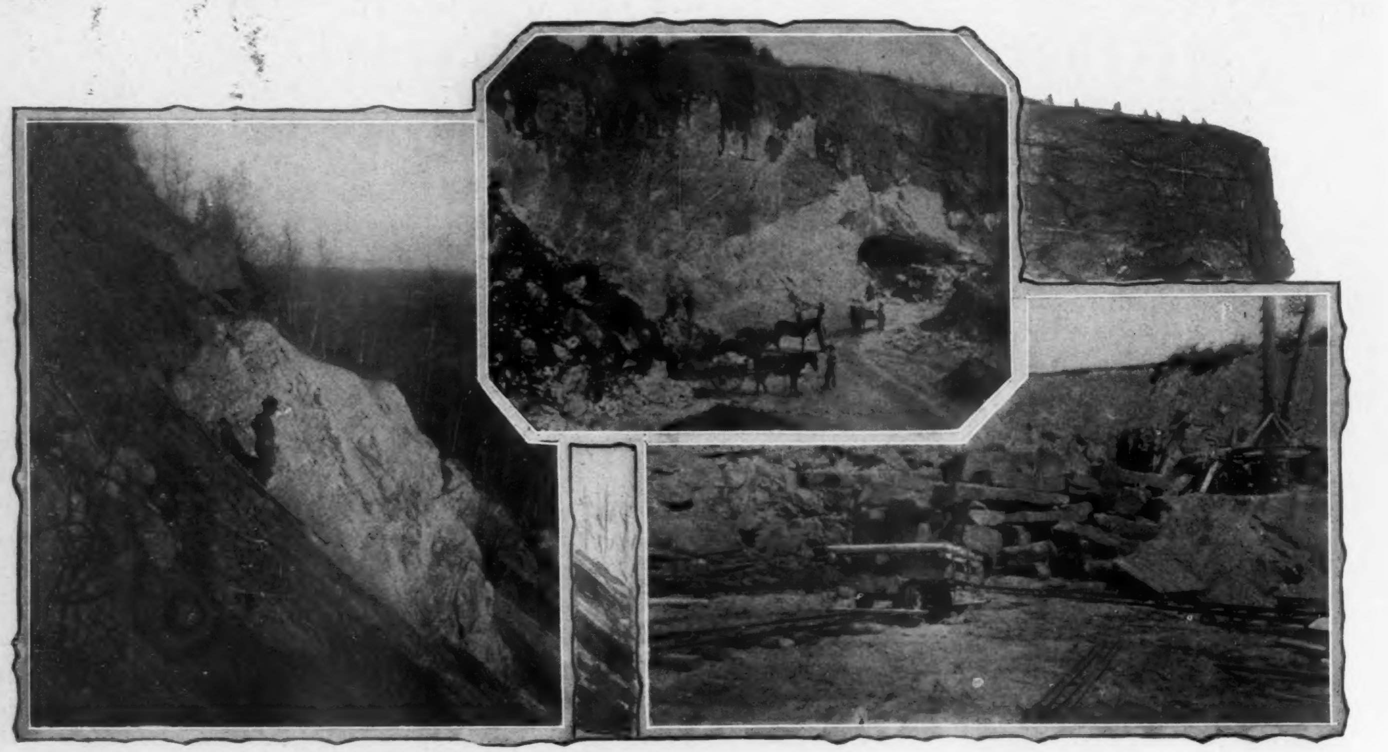
Arsenic has a sort of morbid interest attached to it, having been widely employed in days gone to poison human beings. The poisonous effects of arsenic lie in its sudden administration in large doses, for the people of the Austrian Tyrol eat arsenic to improve their complexion. By commencing with a small quantity and by increasing the daily dose, these people can finally take an amount that would kill anyone unaccustomed to the drug.

At the moment, there is a demand in the United States for arsenic as a means to destroy the boll weevil. This has aroused considerable interest in Canada, as some of the gold deposits of Nova Scotia contain arsenopyrite. The Montague Mine, near Halifax, has recently commenced operations on an arsenopyrite-gold ore; but the greater part of the arsenic produced is derived from the smelting of the silver-nickel-cobalt ores of the Cobalt district, and from the arsenical gold concentrates exported for treatment from British Columbia to Tacoma, Wash.

Canada is the most important source of asbestos—the Province of Quebec, alone, supplying 85 per cent. of the world's total production. But as this Magazine has dealt at some length with the mining of this non-metallic mineral, we shall confine ourselves to the numerous other metals in the group under consideration.

Barytes or barium sulphate, known also as heavy spar on account of its high specific gravity, is found widely distributed in a great many forms, the most common being the white

Associate Editor, Canadian Mining Journal.



Left—Outcrop of diatomaceous earth, 40 feet high, in British Columbia.
Top—Gypsum quarry at Cheverie, Nova Scotia.
Right—Pulpstone quarry in New Brunswick.

massive variety ranging from opaque to translucent. It is generally somewhat stained, and contains small quantities of impurities which have to be removed before it is ready for the market. This mineral serves as a body in the manufacture of paint, as a filler in white lead, and is used in the making of putty. It is also employed in the rubber, textile, wall-paper, tanning, and chemical industries. According to H. F. Spence, of the Dominion Bureau of Mines, there is no lack of barytes ore in Canada; but a single 10-ton mill will suffice to supply the demand for some years to come, as the domestic consumption does not appear to be increasing appreciably.

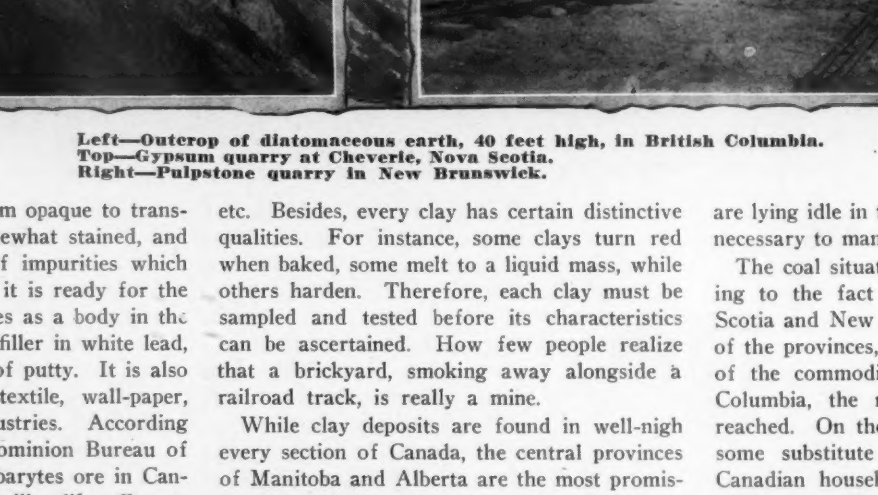
Clay is a substance that gives food for thought, so let us consider it for a moment. Of what are our plates, cups, and saucers made? Clay. Of what are the bricks in our houses made? Clay. Of what are the tiles in our vestibules and the enamel in our bathtubs made? Clay. Of what are the heads of the dolls made with which our children play? Clay.

The uses of clay in its various forms are far too numerous to detail here; but clays, in general, are fundamentally divided into two classes: fire clays or refractories and non-refractories. The refractory clays are utilized to line furnaces, etc., and the non-refractory clays for the making of sewer pipe, brick, tile, etc. Besides, every clay has certain distinctive qualities. For instance, some clays turn red when baked, some melt to a liquid mass, while others harden. Therefore, each clay must be sampled and tested before its characteristics can be ascertained. How few people realize that a brickyard, smoking away alongside a railroad track, is really a mine.

While clay deposits are found in well-nigh every section of Canada, the central provinces of Manitoba and Alberta are the most promising from the viewpoint of development. Kaolin—an alteration product of feldspar—provides the material for pottery when mixed with fine sand and ball clay. Deposits of clays of this sort exist in Canada, in fact pottery industries have been started recently at two places. Thousands of dollars worth of clay articles are imported yearly into Canada while there are lying idle in the Dominion all the resources necessary to manufacture those commodities.

The coal situation in Canada is peculiar owing to the fact that coal is found in Nova Scotia and New Brunswick—the most easterly of the provinces, and then there is a total lack of the commodity until Alberta and British Columbia, the most westerly provinces, are reached. On the other hand, coal, or at least some substitute for it, is necessary to the Canadian householder for nearly six months of the year. Coal, oil, and wood are now generally burned; but it is not improbable that in the near future hydro-electric power will take the place of those minerals for heating houses just as it is now used for cooking, lighting, etc. Fortunately, the provinces of Quebec and Ontario, at present supplied with coal from the United States and Great Britain, are the very provinces where the greatest abundance of waterpower is available.

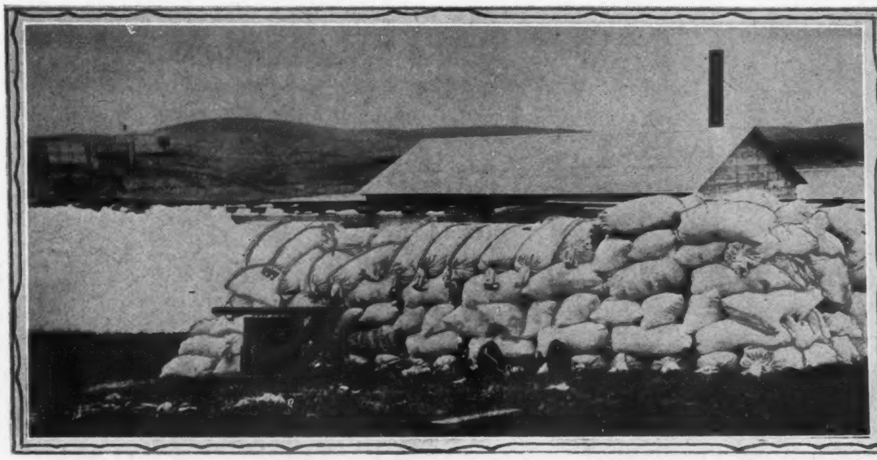
As an example of the advance made in recent years in Canadian coal mining, the Dominion No. 1 B Colliery at Glace Bay, Cape Breton Island, may be cited. This is one of the most up-to-date mines on the continent, and has a daily capacity of 2,500 tons which can be easily increased to 3,000 tons. The main haulageway is supported throughout by 85-pound steel girders which rest on concrete side walls. Mr. G. S. Rice, of the United



Spotted Lake, British Columbia, from which magnesium sulphate or Epsom salts is obtained.

States Bureau of Mines, recently visited this colliery and expressed his approval of the equipment and the methods used there.

Fluorspar or fluorite is a mineral consisting of calcium fluoride. It may be colorless, or range from light to dark purple, and, again, it may be blue, yellow, green, or rose. Not infrequently it is spoken of as spar, fluor, or, when devoid of color, as glass spar. In some cases, fluorite is sold in the crude form as it comes from the pit, but generally it is crushed or ground. The main use for fluorite is as a flux in the metallurgical industries. It is also an ingredient in the composition of enamels for iron and steel ware and in the batch for opal glass. In the chemical industry, fluorite is employed to obtain fluorine and the various fluorides; in the preparation of lead-fluosilicate which forms the electrolyte in the electrolytic refining of lead; and in the electro-reduction of aluminum.



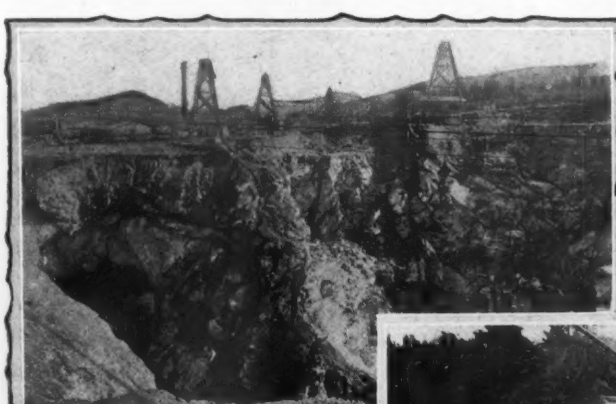
Sodium sulphate bagged for shipment.

Graphite was known in very early times, though its use was probably limited to the decorative arts just as was the case with red earthy hematite—both minerals having been found in prehistoric burial places in Europe. This non-metallic mineral is one of the three allotropic forms of pure carbon, the other two being diamond and soot. It seems strange, indeed, that the diamonds gleaming on milady's neck, the smoke from the oil lamp, and the axle grease for the automobile are in the same class, but so Nature has decreed. It was formerly thought that graphite contained lead, and the names "blacklead" and "plumbago" were given to it on that account. Plumbago has since become a trade name generally applied to the refined product.

Graphite has certain peculiar properties that render the material particularly adaptable for specific uses. These properties are: refractoriness, electrical resistance, toughness, and slipperiness. Owing to these attributes, about 45 per cent. of the output goes into the making of crucibles; 25 per cent. is utilized for the facing of foundry molds; and the remainder plays a part in lubricants, paints, lead pencils, dynamo brushes, dry batteries, etc. Most of the graphite produced in Canada comes from Quebec and Ontario; but the output in recent years has been impeded by the variability of the market and by the lack of efficient methods of concentration. However, the Black Donald Mine, in Renfrew County, Ont., has operated continuously. Shipments of graphite in the first half of 1925 amounted to 662 tons, valued at $39,718.

Next, let us take up gypsum, a hydrous calcium sulphate which, in its natural form, is soft and white. Calcium sulphate without the water content is known as "hard plaster." Gypsum in the raw state is used as a fertilizer, paint filler, filler for cotton asbestos, blackboard chalk, and metallurgical flux. When heated to 400° F. part of the water is driven off, and the resultant product is called plaster of Paris. This is mostly used by builders for walls, moldings, etc.,

The modern tendency is to make the interiors of houses as bright and as comfortable as possible. Often beauty is obtained by simplicity of line, sometimes by ornamentation; but, as carving is too expensive for the general run of homes, gypsum has proved to be a satisfactory substitute as it will take any desired form and retain that form once the material has set. The average citizen, as he looks at the ornamental ceiling of his own house, or the artistic cornices of a public building, might well give a passing thought to the mines and quarries and to the industry that render such



Left—One of the asbestos quarries in the Province of Quebec, which is famous for its deposits of this mineral.

Right—Madoc, Ont., is the center of Canada's talc-mining industry.

Bottom—The Lacey Mine, which is situated in the Province of Ontario, is the world's largest producer of amber mica.

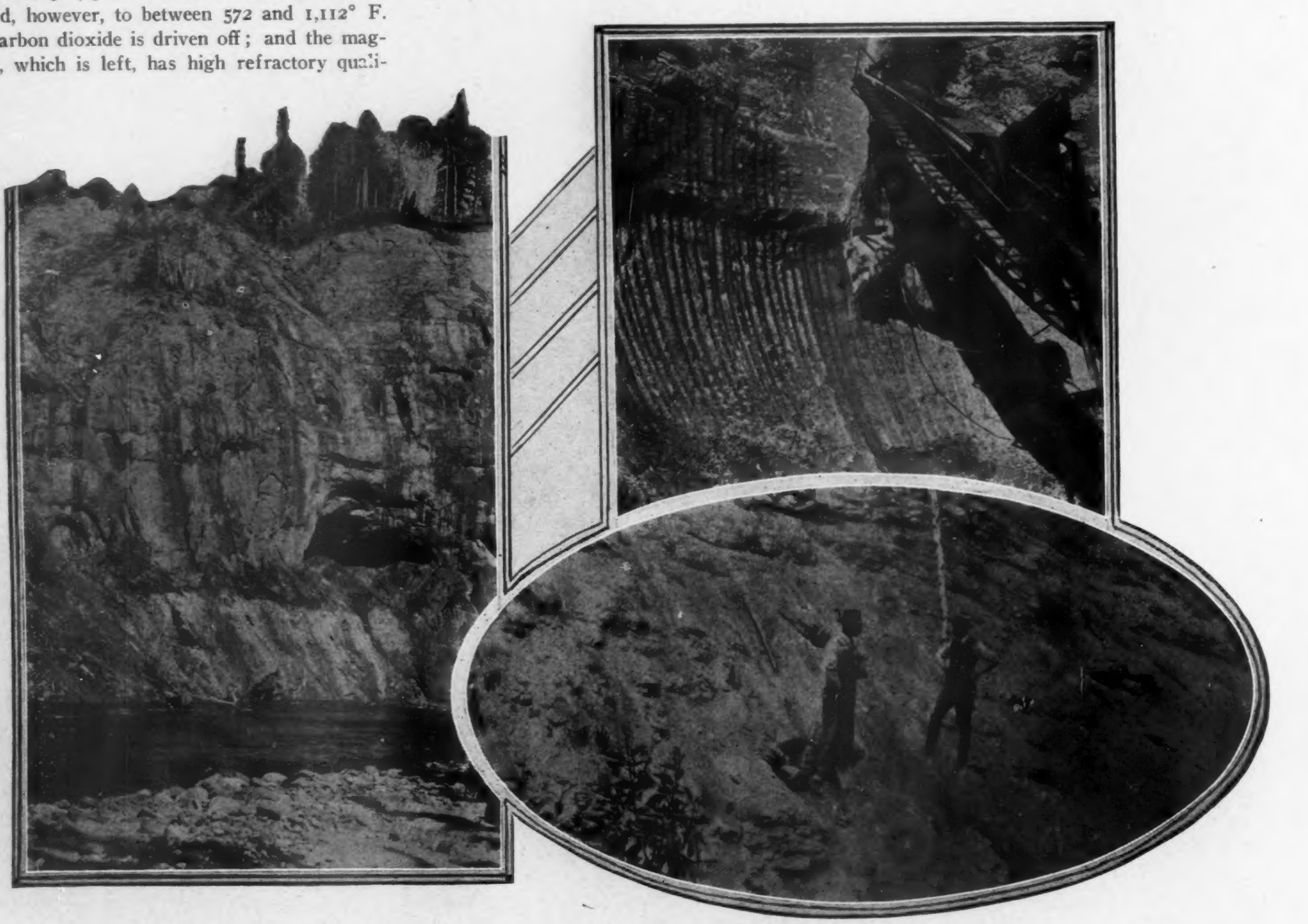
things possible. Gypsum is a common mineral, and is found in workable quantities in the old world as well as in the new. The United States is the chief producer, after which come France, Canada, Great Britain, and Germany in order of importance. In Canada, gypsum is mined in Nova Scotia, New Brunswick, Ontario, and British Columbia.

Magnesite or magnesium carbonate, in its pure state, contains 47.6 per cent. magnesium oxide and 52.4 per cent. carbon dioxide. When heated, however, to between 572 and 1,112° F. the carbon dioxide is driven off; and the magnesia, which is left, has high refractory qualities. Magnesite deposits of importance exist in the United States, Canada, Austria, Hungary, and Greece; and for some years the Austrian and Hungarian product controlled the markets of the world.

Crude magnesite is employed in the manufacture of Epsom salts and of wood pulp produced by the sulphite process. Calcined magnesite is an ingredient in fireproof paint, but its widest use is in the lining of metallurgical furnaces in which high temperatures must be retained for long periods. Calcined magnesite also forms one of the constituent parts of oxychloride cement which is extensively utilized in fireproof and waterproof floors. Fire is excellent as a servant but terrible as a master, and each year greater attempts are being made to prevent the outbreak of conflagrations in crowded centers. Any material that will resist fire and that at the same time can be used in the construction of houses is, therefore, of prime importance. The magnesite deposits in Canada are situated some 60 miles west of Montreal. They have been proved to a depth of 200 feet by diamond drilling; and the quarries, which have not yet attained that depth, ensure an ample supply of the mineral for years to come.

Mica, another non-metallic mineral, is of a highly complicated composition. It exists in such a state in Nature that it needs to be only mechanically separated from the surrounding rock to make it ready for use. There are three kinds of mica: white, amber, and black—the color depending upon the iron content, but only the white and the amber are of commercial value. Mica can be split into very fine sheets, and this characteristic, combined with its transparency and its heat-resisting qualities, makes mica peculiarly suitable for a variety of useful purposes in our daily life. It is employed in the manufacture of diaphragms for phonographs and telephones; in the making of lamp shades and chimneys; for glazing some automobile windows and stove openings; and especially in fittings for the electrical industry. The "snow" for Christmas trees, which is also used to decorate postcards, wall paper, etc., is really ground mica—1,711 tons of which was produced in Canada during the first six months of 1924. India, South America, Japan, and Australia are also sources of this mineral.

Natural gas and petroleum are produced in Canada, and there are still many opportunities for prospecting in untried areas. Work has recently been undertaken by the Department of Mines for the examination of certain bituminous sands in northern Alberta. A street in Edmonton has been paved with three types of surfacing—sheet asphalt, bitulithic, and bituminous concrete—made from this substance. The pavement was laid in August, 1915, and was in good condition, despite heavy traffic, in October, 1923—no repairs having been required in the meantime.



**Left—An outcrop of tar sands, 85 feet thick, on the Athabasca River.
Right—Digging brick-making clay in the Don Valley near Toronto.
Oval—Deposit of pottery clay at Lundbreck, Alberta.**

Quartz is one of the names applied to silica, which is the oxide of silicon. Chalcedony, opal, flint, quartzite, sandstone, sand, diatomaceous earth, and tripolite are also forms of quartz. Who would associate the sand on the seashore with the window panes in his house? Or who would imagine the glowing opal to be akin to the sandstone blocks on which he walks?

Silica enters more into our daily life than perhaps any other mineral, for upon it depends much of our comfort. From what other material could we make windows and yet have the light so necessary to our well-being? Optical

lenses are fashioned from quartz crystals; lump silica helps as a flux in metallurgical operations of one kind or another; silica sand is used in the making of bricks and cement and in the molding of iron castings; and powdered silica plays a part in the pottery industry and in the manufacture of shingles and paint. Owing to the cheapness of the material, underground mining of silica is commercially prohibitive. It is, therefore, either quarried from the solid rock on the surface or dug from the loose sand. Though quartz of all varieties are to be found in the Dominion, some of them are imported from other countries.

At the mention of salt our minds turn naturally to the dinner table, and this recalls the remark of a man who had made his fortune through a condiment. When asked how he had done it, he replied: "It's not what they eat, it's what they leave on their plates." Nevertheless, the gastronomic capacity of the Canadian people cannot account for 102,884 tons of salt, worth $750,839, consumed by them during the first six months of 1924. We find, then, that salt is employed as a preservative in the fish-packing, the dairy, and the tanning industries; in refrigeration processes; in chemical works for making soda-ash, caustic soda, and chlorine, etc. It is also used in the metallurgical treatment of certain gold ores. Four grades of salt are prepared for the market: vacuum-pan granulated, common fine, common coarse, and rock salt.

While much has already been done in exploiting Canada's mineral resources, there are still enormous opportunities for development throughout the Dominion. Just what has been accomplished can be gathered from the fact that minerals worth $6,000,000 were produced in the Province of Ontario in 1893, while the output in the same region 30 years later was valued at $78,000,000—an increase of 1,300 per cent. These facts are merely cumulative evidence of the really amazing mineral wealth of the Dominion; and it now remains for man only to take advantage of the abundance which Nature has placed there at his disposal.

HARBOR IMPROVEMENTS IN CANADA

WORK has been begun on the dredging of Courtenay Bay, New Brunswick, by the St. John Dry Dock & Shipbuilding Company, Ltd., preparatory to the construction of four large docks for the Canadian National Railway. These docks will be capable of accommodating 25 steamers of large size.

The plans for this extensive harbor development include up-to-date freight-handling equipment; a grain elevator with a capacity of 1,000,000 bushels; and numerous permanent warehouses which, when completed, will provide 25 acres of storage space and 70 acres of space for cold storage and for various industrial purposes.

The Dominion Government has authorized the expenditure of $300,000 for the dredging of Courtenay Bay; and it is estimated that the cost of the entire undertaking, involving the improvement of 2,400 feet of waterfront, will come close to $30,000,000.

ONE MORE GREAT LAKE FOR AMERICA

CANADIAN engineers have conveived an elaborate scheme, which ultimately will be international in scope, whereby it is proposed to add a sixth lake to the Great Lakes on the American continent. This man-made body of water is to be larger than Lake Erie and to cover more than double the area occupied by Lake Ontario.

The plan, as outlined by C. Lorne Campbell, of Toronto, is to build a dam on the Albany and the Ogoki rivers, respectively. In this way, the waters from those streams will be diverted from James and Hudson bays into Lake Nepigon, forming a lake 200 miles long and 90 miles wide.

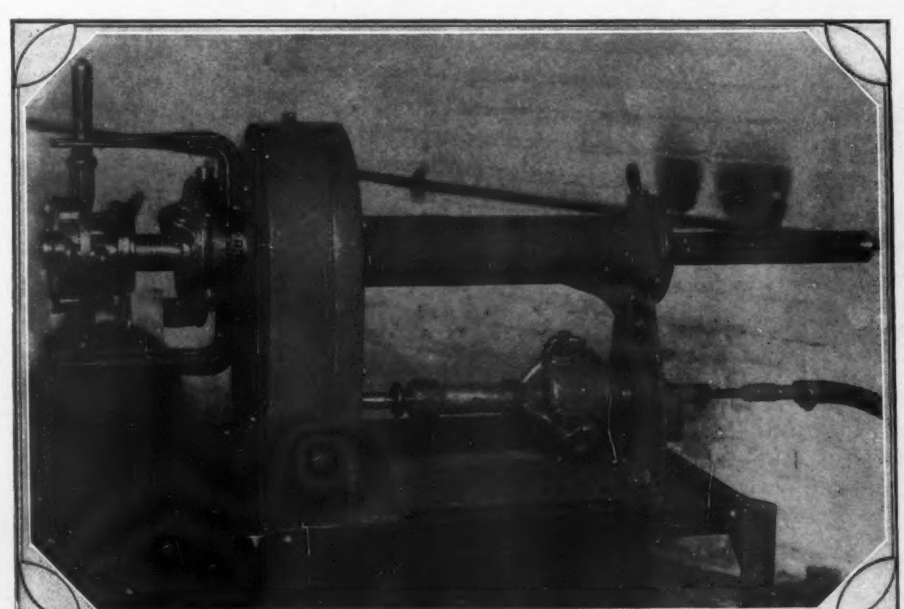
It is estimated that the waters so diverted would increase the block of electric energy now generated at Cameron Falls by from 175,000 to 200,000 H. P.; at Sault Ste. Marie by from 40,000 to 50,000 H. P.; and at Niagara Falls by 300,000 H. P., a total of about 500,000 H. P. Furthermore it is believed that this added flow would offset the present diversion at Chicago and thus ultimately restore the former level of the Great Lakes.

WINDMILL PRODUCES ELECTRICITY

BY MEANS of a specially designed windmill, at Culbertson, Mont., electric current is produced for operating signals on the Great Northern Railway. This is the first installation of its kind, and was made under the direction of H. E. Brashares, assistant superintendent of signals, and L. T. Harris, field engineer.

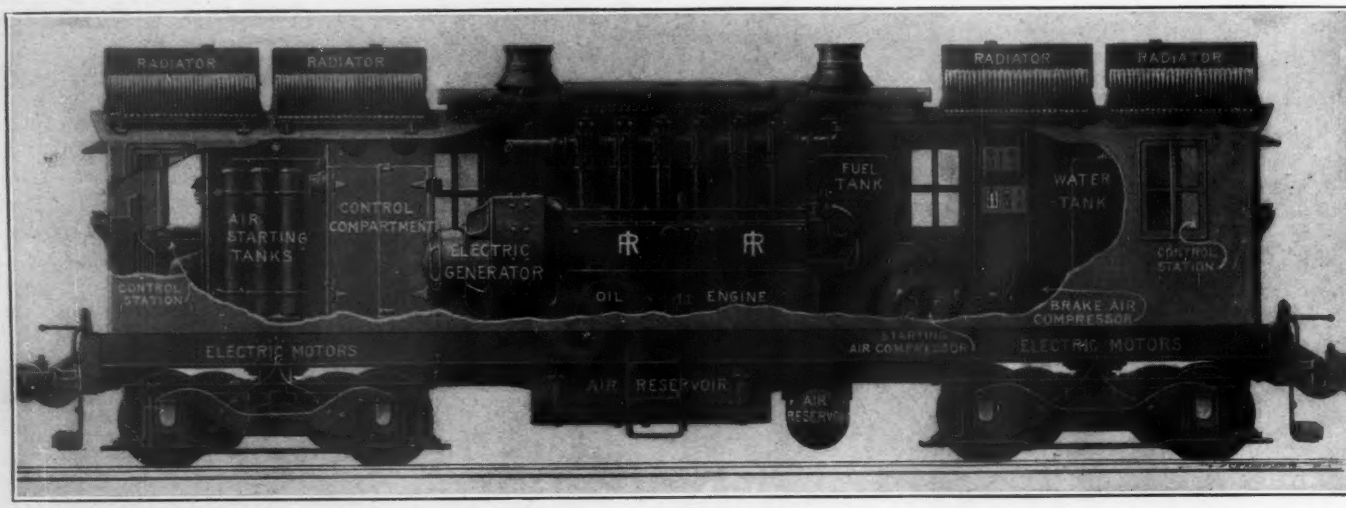
The current so generated is distributed for a distance of 10 miles in one direction and 16 miles in the other. By means of a special governor it is practicable to operate the generator at a nearly constant speed and also to regulate the blade area opposed to the wind, especially in times of storm. One of the important features is a belt drive which, it is claimed, is not affected by sleet, snow, heat, or cold.

Air-driven woodborers make comparatively short work of boring holes for explosive charges when blasting down mine timbers after extracting work has ceased. This procedure is followed when the mining method is what is known as top slicing and cover caving. The object of thus removing the timbers is to bring down the roof successively in short sections rather than to leave standing a considerable roof area which may suddenly drop and cause considerable damage to neighboring workings.



Courtesy, The Oster Manufacturing Company.

The Oster Manufacturing Company has devised a handy portable pipe-threading machine that can be moved readily from job to job. The prime mover shown in the accompanying picture is an I-R air-driven grinder that operates the pipe-threading part of the equipment.



Sectional drawing of the oil-electric locomotive now at work in an important terminal yard in Greater New York. The oil engine drives a generator which furnishes operating current to the electric motors on the four driving axles.

OIL-ELECTRIC LOCOMOTIVE PROMISES ECONOMIES

SECRETARY Herbert Hoover has recently declared that the transportation facilities of the country must keep pace with the demands upon them in order to do their share towards assuring our economic stability. He also pointed out that there is evidence of traffic congestion at "our great railway gateways and terminals" largely because traffic has grown from 114,000,000,000 ton-miles to 388,000,000,000 ton-miles in the course of the last 25 years.

Some of this congestion can be attributed to the handling of cars at terminal points; and any savings in time and expense incident to this phase of railroading should lessen not only congestion but effect substantial operating economies. Added interest is, therefore, aroused in the appearance of the oil-electric locomotive because of the operating economies which the type makes possible. A single instance will show what this new type of locomotive can do.

A 60-ton oil-electric locomotive established in service at one of the railroad terminals in Greater New York, has the following record to its credit. In the course of six days' work, this locomotive handled and distributed 431 cars—moving them on and off 26 car floats. It did that work in 61 hours and 50 minutes, during which time the locomotive consumed fuel. A steam locomotive, in the same service, handled and distributed 431 cars—also on and off 26 car floats, and did that work in 75 fuel-consuming engine-hours. Incidentally, the steam locomotive stood by, with its fires banked and ready for work, for 69 additional hours—burning coal the while.

The total cost of fuel, lubricating oil, water, etc., for the six days in question, was $73.35 in the case of the steam locomotive and only $11.90 in the case of the oil-electric locomotive. Furthermore, during the actual working period, the oil-electric locomotive saved 2½ hours each day.

This oil-electric locomotive is in service in Greater New York and was built conjointly by the General Electric Company, the American Locomotive Company, and the Ingersoll-Rand Company.

GOOD ROADS SHOW

YEAR by year, the Good Roads Show and the work generally of the American Road Builders' Association become more and more important. This is the case because of the continually increasing mileage of the improved highways so essential to rapid and safe travel on the part of multiplying passenger cars and motor trucks.

The whole subject of roadbuilding capable of meeting successfully the demands of present-day traffic is in a state of flux owing to changing service conditions and the desire on the part of highway engineers to produce roadways of a better and a more lasting nature. Incidentally, engineering concerns of one sort or another are equally bent upon manufacturing facilities that will enable contractors to do their work well and rapidly in opening up new highways or in improving existing ones so that they will measure up to modern requirements.

Such being the case, the annual convention and road show, which will be held at the Coliseum in Chicago from January 11 to 15, inclusive, will no doubt prove more interesting and more popular than heretofore. Much has been accomplished by highway engineers and by equipment manufacturers since the show of 1925.

HOW BUSY IS THE BUSY BEE?

IT IS a well-known fact that the name "Busy Bee" is no misnomer when applied to the honey bee; but not until recently has anything been done to determine just how much work the bee must do in flying from flower to flower to gather the delectable nectar.

A honey bee, it has been figured out by a painstaking investigator, extracts ⅛ grain of nectar from a single clover blossom. To do this, it must put its proboscis into 60 different flower tubes. As it takes 7,000 grains of nectar to make one pound of honey, the bee must actually visit 56,000 clover blossoms; and, with 60 tubes to a blossom, this means that the bee must take 3,360,000 draughts in collecting the sweetness necessary to produce but 16 ounces of honey.

Scajaquada Creek Drainage Job Nearing Completion

Work On The Second Section of This Big Buffalo Project Has Been Pushed Along Rapidly by Use of Special Equipment

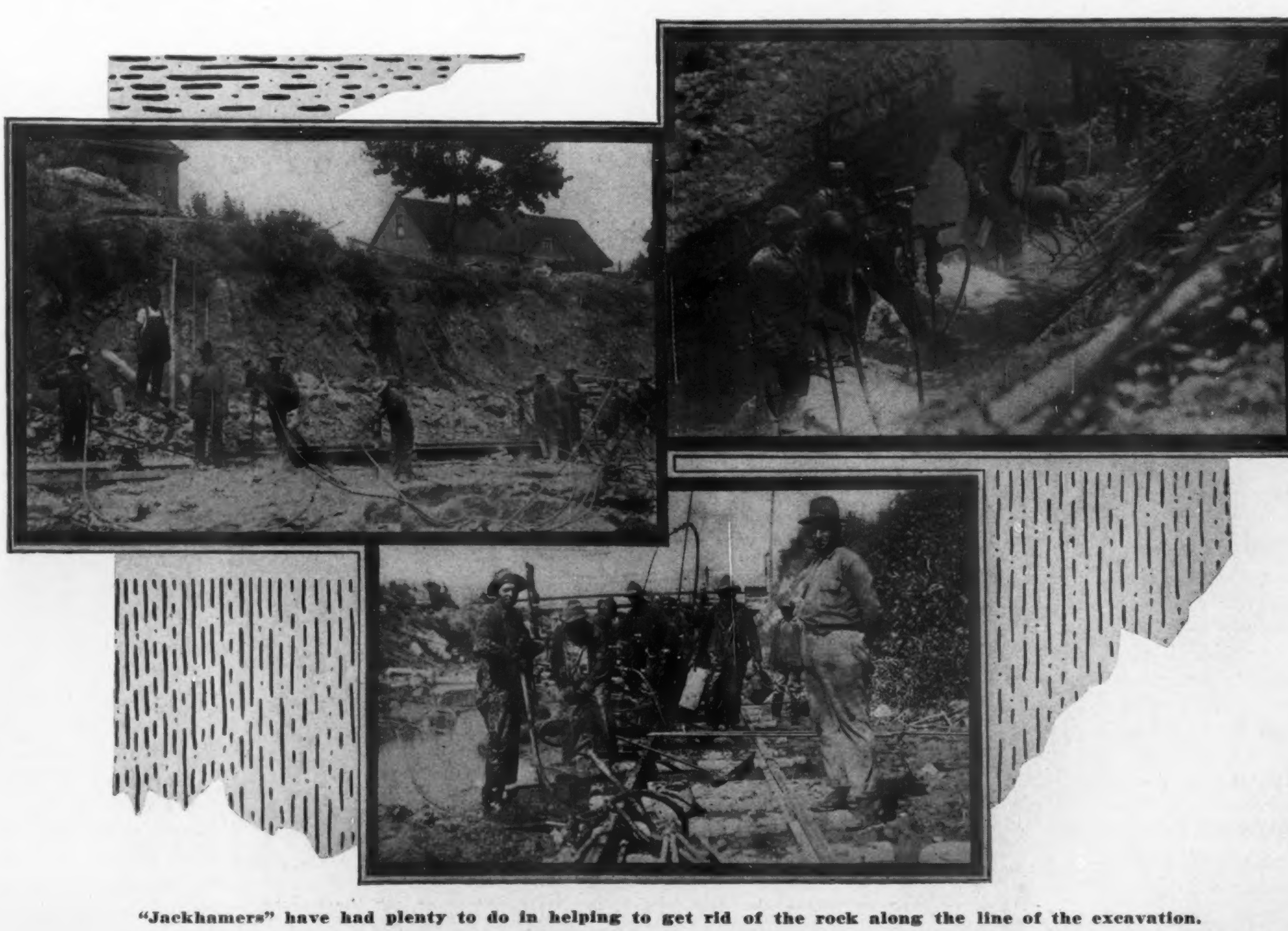
By FRED COLBY

CERTAIN methods employed in carrying out the work in connection with the Scajaquada Creek drainage undertaking in Buffalo have made that job of much interest to the engineering fraternity at large. Scajaquada Creek flows through north Buffalo, N. Y.; and, prior to its widening, deepening, and covering, annual spring freshets caused the stream to overflow its banks and to do much damage to adjacent property. All that, however, has now been done away with. The magnitude of the undertaking, and the important part played by compressed air in pushing the work forward should make the following account of one section of the project of especial interest to students and users of air-power equipment.

A number of considerations, not the least of which was that of sanitation, induced the city authorities to cover the stream—that is, to construct a concrete drain or sewer through which the waters could be carried off. This part of the job involved even greater difficulties than did the widening and the deepening of the creek channel. How, for example, when doing the concrete work, were the forms to be handled without their getting in one another's way and without forcing the contractor to wait until one section had set before putting up the forms for the adjoining section? How was the enormous amount of concrete to be handled? Which would be the best and at the same time the most economical method for cutting the shoulders in the banks for the tunnel arch? We shall endeavor in this article to tell how the work was accomplished and how some of the difficulties were overcome.

In order to provide a suitable foundation and side walls for the tunnel it was found necessary not only to widen the creek bed but to excavate the bottom to a depth varying from 6 to 14 feet. In selecting equipment for this part of the job, air-driven tools were given first consideration. As the creek bottom is of a solid rock formation with an overburden of earth, much blasting had to be done. First the overburden was removed by a steam shovel, and then rock drills made quick work of putting down the holes preparatory to blasting. In drilling, a troublesome formation of limestone, blue flint, lime, and mud seams was encountered; but the "Jackhamer" drills on the job were equal to the test. "Jackhamers" were also used for cutting the arch shoulders in the banks. Two compressors, conveniently located, supplied the power for the drills; and a No. 50 sharpener and an oil furnace insured a full quota of sharp steels for the drills at all times.

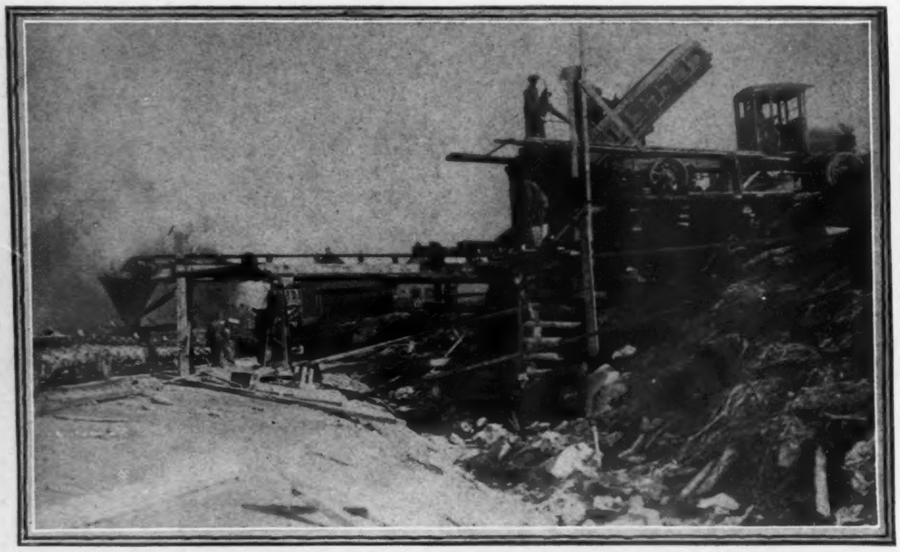
The Scajaquada project was divided into three sections or contracts. The first section of a little more than a mile, which has been completed, was described in the pages of this magazine some years ago; the second section is the one now under consideration; and the third section, which involves little rock work, is just being started. The contract for the second section was awarded to Frank L. Cohen, Incorporated, of Buffalo. This section is about



"Jackhamers" have had plenty to do in helping to get rid of the rock along the line of the excavation.

a mile and a half long, and generally follows the natural course of the stream.

Except in unusual cases, the work of excavating proceeded as follows: first, a center cut 24 feet wide was made, and then two side cuts—including the shoulders for the arch—were dug. The entire channel was 40 feet wide. The broken rock was loaded into suitable cars by a steam shovel and hauled away to a rock storage pile. None of this rock was used in the concrete for the drain. Instead, it was delivered to a crushing plant, operated by the contractor, where it was turned into crushed rock for the market. When completed, the inside dimensions of the drain measured 34x14 feet.



Belt conveyers by which concrete was moved from convenient hoppers, at street ends, and carried to points where forms were erected for placing that material.

The concrete flooring was laid either by damming the stream at some places, thereby temporarily diverting the flow, or by the use of a mixture that is designed to set under water. Of course, this part of the work progressed more rapidly wherever the water was low or the bed nearly dry. It might be mentioned here that the flow in dry weather varies from 5 to 20 foot-seconds but that it sometimes reaches anywhere from 500 to 1,000 foot-seconds between October 31 and May, inclusive. It will be noted in an accompanying photograph that the floor is a separate piece of concrete work made to adhere closely to the side walls. These side walls, in turn, constitute an integral part of the tunnel arch. At times, high water presented a serious problem, as is brought out in one of our illustrations. Under working conditions such as these, it was no wonder that the resourcefulness of the contractor was taxed to the utmost; but, despite discouraging obstacles, Frank L. Cohen, Incorporated, placed 7,500 linear feet of concrete in 80 days. The excavating which preceded this concrete work required a year and a half for its completion.

Because of the proximity of dwellings, extreme care had to be exercised in blasting the creek bed. A shower of broken rock might easily have damaged near-by houses if it did not injure or kill some of the occupants. Moreover, the wracking effect of continuous explosions might have caused foundations, walls, etc., to crack and thus to weaken buildings. To avoid such contingencies, the contractor chained a number of 6-inch logs together loosely and placed this "blanket" over each powder charge. While the force of each blast was strong enough to lift the logs a few feet from the ground, this method effectually prevented the widespread scattering of rock with its attendant dangers.

To expedite the placing of concrete, the contractor decided against the use of old-fashioned forms and form supports. So, together with the city engineers and the engineers of the Blaw-Knox Company, a collapsible type of form with motor-driven carrier was devised that could be handled with exceptional facility. The equipment included 450 linear feet of forms divided into 18 sections of 25 feet each. Every section was strong enough to support its load of concrete without the aid of the traveler, which was intended only to shift the forms from place to place.

For the purpose of raising and lowering the forms, the traveler was equipped with a platform that could be raised and lowered between four guide posts. Means were also provided whereby the sides of a form could either be pushed out or pulled in when erecting or dismounting a form. So flexible were these forms that it was possible to narrow or to widen them according to the cross section of the drain; and, again, they could be sprung out on curves and made to follow as closely as practicable the general contour of the arch.

In placing the concrete on the forms it was advisable, of course, to raise the twisted rods of reinforcing steel several inches above the surface of the forms so as to thoroughly embed the bars and to insure a strong, homogeneous mass. This was accomplished by means of rectangular cement props—shown in one of our photographs—around which the concrete was poured, thus forming a solid reinforced-concrete arch for the drain. Speed in form handling, however, also called for speed in another direction. How was the concrete to be transported to keep pace with the demands of the big broad-backed forms? Generally, the crown of the drain was much lower than the banks of the creek; and it was not practicable to use the bottom of the cut for hauling the concrete. The problem was solved by developing a system of belt conveyers.

Trucks, which had access to the cut only at intersecting streets, emptied the mixed concrete into a hopper which, in turn, fed the material from the bank down onto the top of the conduit by way of a 40-foot belt conveyer. From this belt the concrete passed onto another belt conveyer, 310 feet in length, which distributed its load to all points of the work lying between any two adjacent cross streets. Both conveyers were operated by electric motors; and the 310-foot conveyer was mounted on wheels to facilitate moving it along the top of the structure as the concreting advanced. By this system it was possible at all times to supply the concrete necessary for the side walls and the arches. At the discharge end of the long conveyer, which was cupped to hold the material in place during its travel, the concrete was dumped into a swinging chute. This chute had a

Section of the excavation showing how banks were cut away for the concrete arch shoulders.

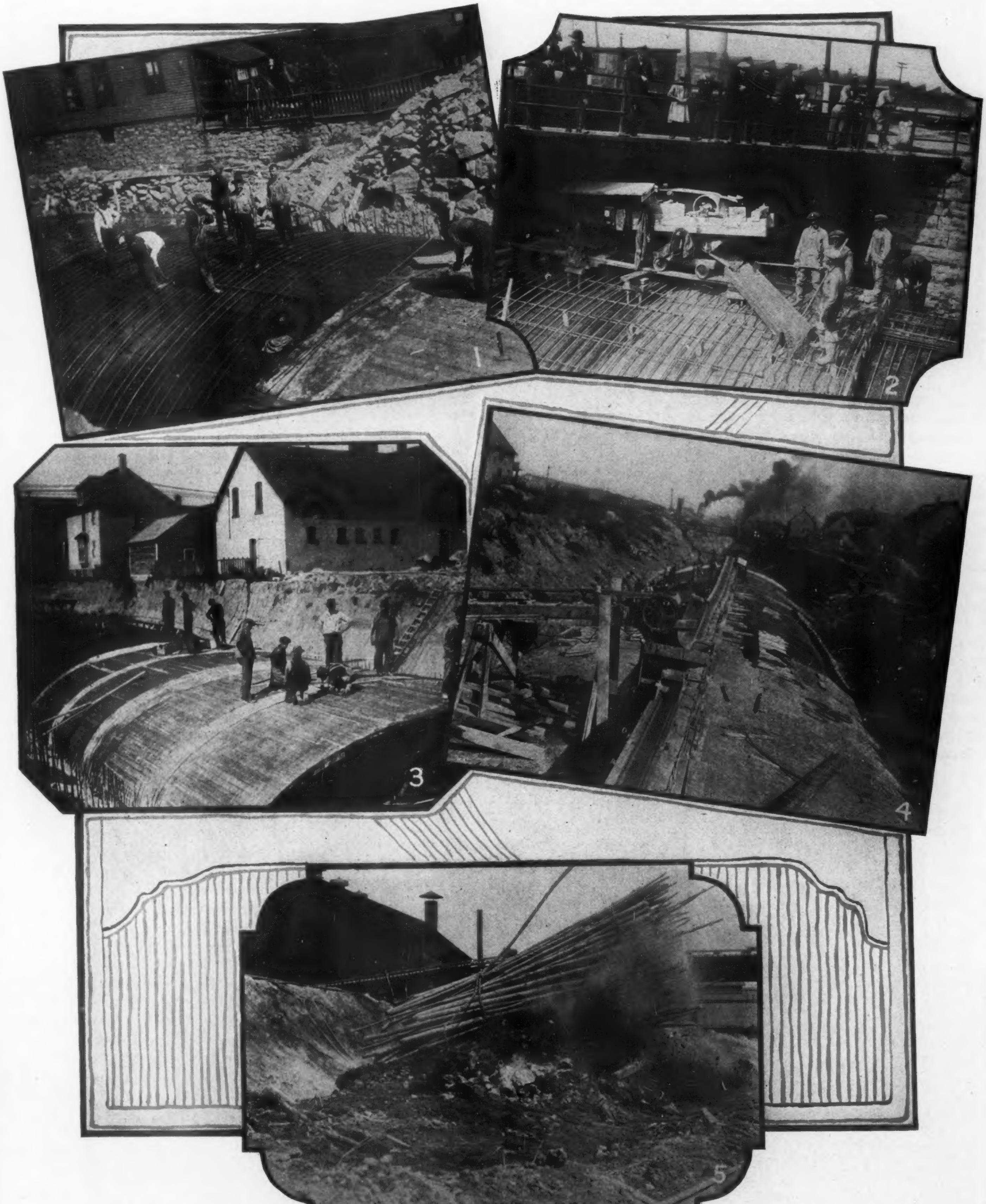


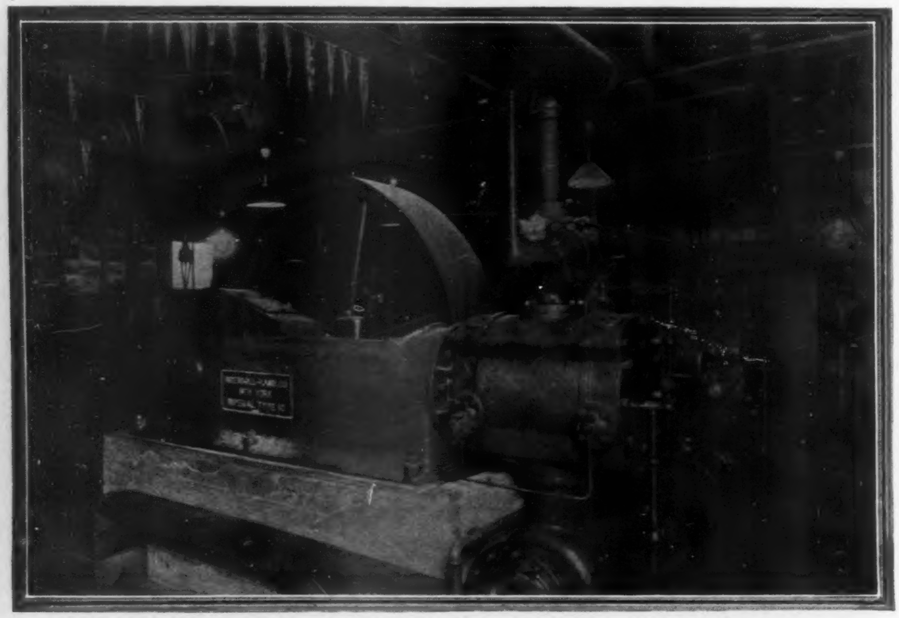
Fig. 1—Assembling the reinforcing steel over the arch forms.

Fig. 2—Concrete blocks were used to hold the reinforcing steel away from the supporting forms before pouring the concrete.

Fig. 3—Assembling the wooden forms on portable form supports.

Fig. 4—Cross-belt conveyers by which cement has been transported to the placing points.

Fig. 5—Fagoted sticks used to blanket blasts.



One of the two 900-foot compressors which furnished operating air for the job.

long enough reach to place the material for the side walls and the haunches of the arch.

Progress was somewhat hampered by gas and water mains which intersected the drain at various points. These mains had to be shifted without in any way interrupting the respective services. Obviously, this work had to be handled with great care; and it was temporarily accomplished, and without interfering to any great extent with the regular activities, by carrying the pipe lines well above the banks of the creek and by suitably supporting them until such time as they could be properly disposed of. Suspension bridges of simple construction also had to be built to enable pedestrians to cross the gap at different points. And so that it might be possible to have access to the drain for the purpose of making repairs, manholes have been placed several hundred feet apart all along the length of the drain. These manholes project a few feet above the top of the sewer. With the concreting finished, the earth previously excavated from the creek bed was used to backfill the drain to grade.

There are three outstanding factors in this work that have helped to make the job a profitable one to the city and to the contractor alike. These factors are: form handling, concrete handling, and rock drilling. By reason of expeditious form handling and concrete handling the contractor was able to do at least 75 or 80 linear feet of concrete work a day, and this figure was considerably exceeded on numerous occasions. But speedy form handling would have availed little without an adequate supply of concrete at all times; and concreting could hardly have been pushed ahead as rapidly as it was if air-driven drills had not made large-scale drilling and blasting operations practicable. The efficiency of modern methods and of up-to-date equipment and machinery was never better illustrated than in the successful culmination of this big undertaking.

EFFICIENT UTILIZATION OF LOW-GRADE FUEL

OWING to the conditions faced by the German coal industry during the postwar years, Germany has been compelled to do everything possible to attain greater efficiency in the burning of coal. In the beginning, when production was at a low ebb and a serious coal shortage threatened, much attention was directed towards finding ways to utilize coal to better advantage. As a result of the work done along this line, modern boiler equipments that had previously ranged in efficiency from 55 to 60 per cent. now attain an efficiency of from 65 to 70 per cent.

New roasting methods and the introduction of coal-dust firing in metallurgical plants have made it possible to satisfactorily employ low-grade fuels. Better utilization of the heat in the steam so raised has also brought about economies. In plants which operate under conditions requiring fluctuating steam pressures, savings have been effected by storing the steam for later use. The economies due to these practices are estimated at 15 per cent.

One of the outstanding developments in this matter of fuel consumption is the increasingly efficient use that is being made of low-grade lignite, or brown coal, having an average calorific value of 2,200 B. T. U.'s. In 1913, German bituminous production was about 190,000,000 tons, while the lignite output amounted to 87,000,000 tons. The peak lignite production was reached with 137,000,000 tons in 1922. In that year but 130,000,000 tons of bituminous coal was mined.

The principal consumers of brown coal in Germany are the electric power plants. In 1913, lignite was the source of 23 per cent. of all the electric current generated in Germany as against 41.2 per cent. in 1922—an increase of about 80 per cent. The significance of this growing demand on the part of these public-utility companies is made clearer when it is known that current generated by the burning of lignite can be transmitted a distance of 186 miles and still compete with energy produced from bituminous coal at the point of use.

Much of the electric energy consumed in Berlin is generated at the Golpa-Zchornewitz brown coal pits, which are about 81 miles distant. It has been estimated that the energy thus produced and distributed by wire releases daily anywhere from 500 to 800 freight cars—each having a capacity of 10 tons—previously needed for the carriage of coal. Besides the Golpa-Zchornewitz power plants, many other stations furnishing light and power for industrial and household use throughout central Germany burn lignite. Furthermore, numerous large individual plants—such as the Piesteritz carbide and calcium cyanamid works, the aluminum works at Lausitz and Bitterfeld, electrochemical works, etc.—burn brown coal under their boilers. But the brown-coal deposits are not entirely confined to central Germany: there are large areas of low-grade lignite in Westphalia, and these, likewise, are undergoing extensive development.

Aside from the savings brought about through mechanical developments of one sort or another, the utilization of coal by-products, of blast-furnace gases, and of process steam have also effected significant economies. For example, at the Union Steel Works, in Dortmund, the power required throughout the entire plant is derived from blast-furnace gases—coal being used only for firing locomotives and for certain special purposes.

Despite flood conditions, the steam shovel continued its work.

New York to Have World's Largest Medical Center

By H. H. STARKEY

THE curious-minded man, strolling in the vicinity of 168th Street and Broadway early in 1925, might have wondered what was the significance of the sound of drum-fire issuing from behind a high wooden fence encompassing some 20 acres of ground—the site of the old American League Baseball Park. And while the first appearance above the fence of structural steelwork might have satisfied his curiosity to some extent, still he probably was not content until he had found out that the drum-fire was the noise made by a battery of rock drills and that the steel framework rising against the skyline was but the beginning of a group of buildings eventually to be known as the New York Medical Center.

A MONUMENT to the spirit of humanity is probably the best definition of the great medical center which is being created in New York City. Non-sectarian, and the united expression of the state, the medical profession, and the people at large, the institution is to offer comprehensive facilities not heretofore coordinated in a single undertaking of a kindred nature.

Apart from the broad and commendable purpose of the New York Medical Center, the project should be of special interest to the readers of this Magazine because of the air-driven tools which are being used to excavate thousands of cubic yards of rock, so that the buildings shall rest on firm foundations, and to bind together the steel units forming the framework of the several associate structures.

A medical center, as understood by the profession, is a collection of buildings devoted to the three branches of medicine: teaching, hospitalization, and research. The idea is not new. In Boston, a number of hospitals have been built around the Harvard Medical School. In St. Louis, Chicago, Montreal, and Vienna—among other large cities, the idea has been carried out to a greater or lesser extent. The prestige of Johns Hopkins University has been increased by the wise action of the authorities that brought about the coördination of the student body, the general hospital, the clinic, and a special institute. But the new Medical Center in New York City, when completed, will surpass anything of the kind ever attempted. And this is as it should be, for Greater New York is one of the world's largest cosmopolitan cities, harboring within its gates men of every race and subject to many different maladies or physical ailments.

The germ of the present medical-center idea was conceived back in 1911, when the authorities of Columbia University and the Presbyterian Hospital made an arrangement whereby the students of the College of Physicians and Surgeons could get first-hand knowledge through personal observations at the hospital and under the tutelage of the staff, also members of the College faculty. There was one handicap in this arrangement—the university was situated at least two miles from the hospital. The resultant loss of time and the inconvenience induced Dr. Samuel Lambert—then Dean of the College of Physicians and Surgeons—to work out a scheme ten years ago for a New York medical center. The keystone of this medical center was to be a building to be shared by the Presbyterian Hospital and the Columbia surgical and medical school.

A site was donated by Mrs. Stephen V. Harkness and Edward S. Harkness. In 1917, owing to our participation in the World War, the undertaking had to be abandoned for the

How the central group of buildings will appear when finished in 1927.

© Fairchild Aerial Surveys, Inc.

The large rectangular space in the center of the picture is the expansive site upon which the New York Medical Center will be reared.

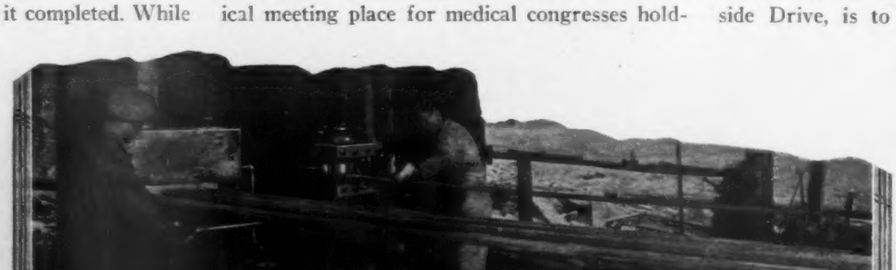
time being. However, in 1921, a Joint Administrative Board came into existence, and Dr. C. C. Burlingame, who had been director of medicine and surgery of the American Red Cross in France and later an organizer of industrial medicine, was fittingly made the executive officer. The present undertaking is being carried out according to the well-matured plans laid out by Doctor Burlingame after three years' study of the medical centers in this country and in Europe.

The nucleus of the Medical Center will be an imposing building which, besides the Presbyterian Hospital, is to house the Private Patient Pavilion, the College of Physicians and Surgeons of Columbia University, the Sloane Hospital for Women, and the Vanderbilt Clinic. Ground was broken for the structure on January 31, 1925; and, if expectations are realized, the summer of 1927 will see it completed. While the tower surmounting the edifice will reach 303 feet into the air, the building will have an average height of 255 feet, and the main axis—running east and west—will measure 321 feet. As shown by one of our illustrations, this axis is to be continued on the west side for a matter of 156 feet, and it is in this part of the structure that the Private Patient Pavilion will be located. In addition, there will be a number of wings, extending southward, each of which will be 60 feet long and 30 feet wide. This central group of buildings, for that is really what it amounts to, will cost in the neighborhood of $10,000,000.

The general hospital will occupy 14 floors of this huge structure, the first 4 to be used for administrative purposes and the remainder for wards. These wards will really be a series of small hospitals, each complete in itself. There will be 64 beds to a floor—divided into rooms of 1 to 12 beds, together with sun parlors, dressing rooms, treatment rooms, laboratories, and diet kitchens. On the 13th and 14th floors will be the Sloane Hospital for Women, while the entire 15th floor is to be set aside for surgical work. There will be 8 operating rooms and an amphitheater, costing $75,000. The purpose of the amphitheater, capable of accommodating 135 people, is two-fold: it is to be used for teaching and to serve as a clinical meeting place for medical congresses holding sessions in New York City. Each of 6 of the operating rooms will be provided with a screened mezzanine so as to enable students and visitors freely to observe operations.

In order that there shall be nothing lacking to make the Medical Center complete and up-to-date in every respect, the floor above the operating rooms is to be turned into a recreation roof with glass-enclosed loggias, a large music and rest room, and a 60x35-foot gymnasium which is to be equipped for the use of the patients and for the members of the staff. Structural steelwork on the hospital is now well underway, and an army of masons have begun laying the brick walls. So much for the main or central group of buildings.

Work on the foundation for the Presbyterian School of Nursing Residence has been started. This structure, overlooking Riverside Drive, is to be connected with the hospital by a tunnel running under Fort Washington Avenue. The next building to go up on the site will be the 20-story State Psychiatric Institute and Hospital. Five years ago, the New York State Legislature passed a law authorizing the construction of a state hospital which was to provide for "the study of the causes, the nature, and the treatment of diseases affecting the mind, brain, and nervous system, and for the discovery and application of more efficient measures



The drill steels used in excavating rock on the site of the New York Medical Center have been heated and sharpened by a No. 25 oil furnace and a No. 50 "Leyner" sharpener.

of prevention, treatment, and cure of such disorders, * * * besides conducting courses of instruction for physicians." So that the Presbyterian Hospital and the State Psychiatric Hospital might enjoy a complete interchange of facilities for the general good it was agreed by the authorities in question that the State Psychiatric Hospital, together with the State Psychiatric Institute—now on Ward's Island, should become a part of the Medical Center. Further, plans are now being prepared for the Neurological Institute and for the Babies' Hospital; and buildings for other special institutions are to be designed later on. Among those that have expressed a desire to locate on the site are: The Columbia College of Dental and Oral Surgery, the Crocker Institute of Cancer Research, and the College of Pharmacy of the City of New York.

"Jackhamers" putting down bench holes ranging in depth from 18 to 20 feet.

Dr. Nicholas Murray Butler, President of Columbia University, in speaking of this monumental undertaking, recently said: "New York, sitting at the gateway of a continent, bearing the burdens of a great people, having contacts more numerous, more manysided than any other community in the modern world, will depend for its fame, for its satisfaction, and for its enduring reputation upon the institutions that it builds to give voice and expression to its capacity to serve both God and man. In this great enterprise we are doing for medicine, for surgery, for the public health, everything that science and art and generous endeavor can make possible."

HEATERS TO SAVE HELIUM IN AIRSHIPS

HELIUM is far too precious a gas to be valved freely from a lighter-than-air dirigible, as is done where the buoyant medium is comparatively inexpensive hydrogen. Therefore, inventive minds have been directed towards finding ways by which the effects of valving or releasing of the buoyant gas might be obtained without dissipating helium into the surrounding atmosphere. Upon the solution of this problem depends in a measure the commercial development of airships using a non-inflammable gas.

As everyone knows, the density of the atmosphere varies with barometrical conditions and with the temperature of the air during daytime and nighttime. Accordingly, the lifting or weight-carrying capacity of the gas available for that purpose within a dirigible varies agreeably to the changes mentioned. To neutralize these changes so as to keep a dirigible aloft or to enable her to descend, it is customary to dispose of dischargeable ballast or to permit the escape of the ship's buoyant gas. In short, the safe or efficient operation of the dirigible depends upon the juggling of ballast and reserve buoyancy.

Various ways have been proposed for the control of the two essential factors just mentioned, but none of these has been altogether satisfactory or practicable. Two European chemists have recently offered another solution of the problem, which is an interesting one even though its effectiveness in service has yet to be established. In principle, the scheme consists primarily of the use of electric heaters—the electric energy being developed by the aircraft's machinery during flight—which would be counted upon to induce the expansion of the helium and thereby increase the buoyant effort of a given volume of that gas. Conversely, by permitting the gas to cool and to contract—thus reducing its volume—the buoyant effort would be lowered and a condition brought about which would be analogous to that obtained by allowing so much gas to escape into the atmosphere.

There would seem to be no technical obstacle to the employment of such a system of buoyancy control provided the heaters were not objectionably heavy and provided, further, that the temperature of the helium could be changed quickly to neutralize or to take care of rapid changes in the altitude of the aircraft.

Left—Excavating in rock for the foundations of some of the Medical Center buildings.
Right—Three of the numerous "Jackhamers" on the job drilling 18-foot toe holes.

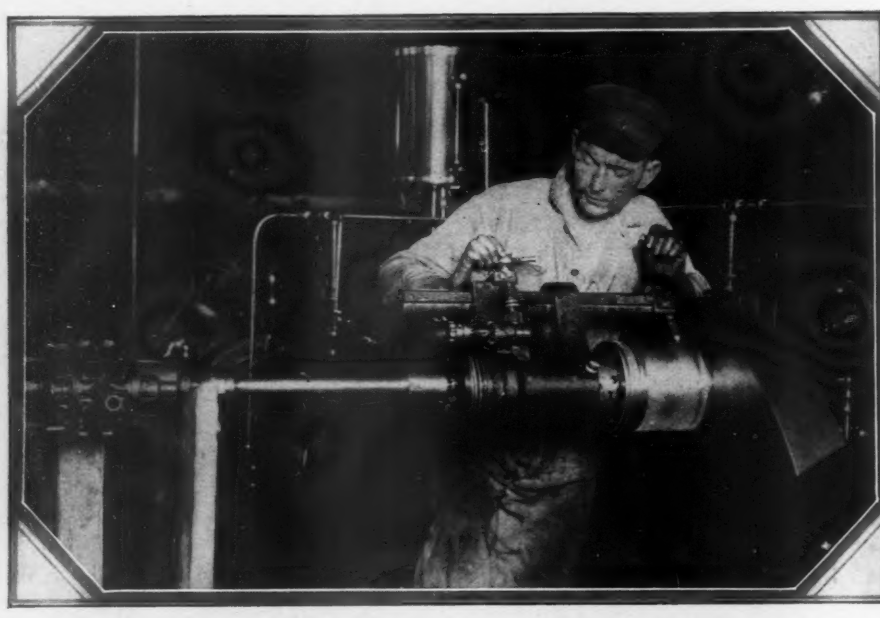
IMPROVED TYPE OF PORTABLE CRANK-PIN LATHE

A. M. HOFFMANN

THERE has recently been put on the market an improved type of portable crank-pin lathe that is operated by an air-driven drill. According to C. E. Marsh, the designer and builder, the machine has been thoroughly tested in refrigerating and packing plants, as well as in roundhouses and locomotive repair shops. The lathe can turn crank pins having a diameter of from 3½ inches up to and including 11½ inches; and, without changing bars, is capable of handling a pin 20 inches long.

The lathe is equipped with two independently operated tool bars that are built into the machine and thus make it possible to save the time otherwise wasted in changing bars when taking up another piece of work. Time is also saved by reason of the speed with which fed out to the work by means of a gear rack that also serves as a key to keep the bars in proper alignment. The feed motion for the bars is effected through a worm on the spindle, which is enclosed and operates in a bath of lubricating grease.

The spindle is made of cast iron; is tapered and bored out at the larger end; and is threaded internally so as to screw onto two master adapters that make it possible to adjust the machine to any size or style of crank pin now in use on standard railroads. One of these adapters, designed for crank pins having outside valve motion, is suitable not only for the largest size pins but, through the aid of bushing, can also be made to fit the smallest sizes —thus avoiding the use of equipment that is required for this work when done on other types of portable lathes. This particular adapter is threaded on the outside to fit the crank-



Marsh portable crank-pin lathe turning a chrome-nickel-steel crank pin on an ice machine in a large packing house in the South.

the tool bars are moved to and from the cutting position. The feed is automatic and constant; an improvement over the old-fashioned star feed. However, there is a hand feed for each bar for the purpose of working out fillets and corners on crank pins.

Both bars can be used at one and the same time to perform two different services—that is, one for turning a rough cut and the other for turning a finished cut, or both bars can be operated simultaneously for turning two different-sized journals on a main crank pin. In this way the work can be done in one-half the time that would be required if it were done on any other type of portable lathe. Likewise, it is possible by the aid of a burnishing tool or roller—designed to work in one of the tool bars—to polish a journal while the other bar is cutting.

The ends of the tool bars are provided with handles that permit setting the cutting tools at any desired angle without the necessity of using bent tools or without offsetting. The bars are made of high-carbon tool steel; are 2 inches in diameter and 34 inches long; and are pin machine. The second adapter is designed for crank pins with threaded ends, counterbored ends, and for pins having flanged collars.

To return to the spindle, the smaller end is bored and bushed for the driving and the intermediate shafts, and is threaded on the outside so it can receive two thrust collars and be adjusted to take up any wear on the spindle or on the rotating cylinder. The smaller end of this rotating cylinder, which is bored out and tapered to fit the spindle, is counterbored to take the internal gear that drives the cylinder.

The drive of the mechanism is effected through gears: a spur gear works into two intermediate gears which, in turn, drive the internal gear in the rotating cylinder. As a safety-first measure, both the driving gear and the gears being driven are encased in the spindle and the rotating cylinder. As previously mentioned, the actual motive power of the lathe is an air drill; and it is revealing no secret to mention here that Mr. Marsh, in a new design, plans to bolt the motor to one end of the machine and thus to make the air drill an integral part of the lathe.

With the bars in place, the improved lathe weighs 225 pounds, but without them the weight of the machine is 155 pounds. This makes it possible to move the lathe from one job to another without calling for the services of a labor gang, as is so often the case with other types of crank-pin lathes. In comparison with the older machine designed by Mr. Marsh, the improved lathe can get anywhere from 3 to 5 inches closer to the work, and this not only obviates great tool overhang when turning a long pin but permits shorter bars to be used, thus cutting down weight. Furthermore, by placing the tool bars on opposite sides of the rotating cylinder, the lathe is better balanced or, expressed differently, is more rigid and therefore capable of producing a smoother and more finished piece of work. The machine can be set up and started within a period of five minutes.

To quote Mr. Marsh: "The lathe has many new mechanical features that make it a great labor-saving machine in railroad and industrial repair shops, and especially for repair work connected with power houses where the machinery is too large and heavy to be dismantled and carried to a machine shop. The lathe is now being used by trunk-line railroads and in repair shops generally where it has undergone all kinds of tests within the past twelve months. These tests have proved conclusively that the machine is capable of doing the work for which it is designed in about half the time required by the run of crank-pin lathes engaged on the same kind of work.

ITALY TO DRAW MORE POWER FROM ALPINE SOURCES

ALPINE glaciers and the heavy coverings of snow cloaking parts of those towering mountains will furnish motive power for two new hydro-electric plants having a combined capacity of 83,300 H. P. The falling waters emanating from the glaciers and the snow will drive the turbo-generators to be installed at Pallenzeno and Rovesca.

According to a news report, it will not be necessary to erect dams to impound the flow inasmuch as the melting goes on continuously and at a rate which will insure at all times an ample supply of water to drive the turbo-generators. Even though the minimum volume may not seem large, still the head available will always be a high one and provide sufficient energy to insure the steady development of more than 88,000 H. P.

The two new plants will be in the neighborhood of Lake Maggiore; and most of the work in connection with their development has been centered in driving a 17-mile tunnel through solid rock. This, of course, has necessitated much drilling and blasting. The Pallenzeno and Rovesca power houses will be linked with the well-known Italian Edison superpower system which, with the new stations, will have a total generating capacity of 1,060,000 H. P.

The trade returns for the fiscal year 1925 indicate that seven years of slow but steady growth have at last restored the volume of international trade to its pre-war level.

Making Valves For Many Purposes

In This Branch of Industry Compressed Air Can Be Used to Speed Up Production and to Insure a Superior Product

By ROBERT G. SKERRETT

VALVES are no less essential than piping in any system designed to handle and to distribute liquids or gases. It is important that the fluids shall be under complete control so that the stopping or the regulating of the flow can be effected quickly and at any time. Incidentally, the thoroughness of this control will depend to a large extent upon the character of the valves employed in each case and also upon the reliability of those valves under all service conditions.

The accompanying article describes some of the facilities used by a valve-manufacturing company which has been engaged in this special department of industry for more than half a hundred years.

AN industrial enterprise that has remained in business for 50 years; that has made a steady growth and progress; that has been able to meet changing mechanical and trade conditions; that has combined quality craftsmanship with modern demands for quantity production; and that has held the confidence of the public over the entire period has to its credit a notable achievement. This accomplishment was referred to by the management of The Chapman Valve Manufacturing Company when the company, two years ago, celebrated its golden anniversary as an industry in Indian Orchard, Mass.

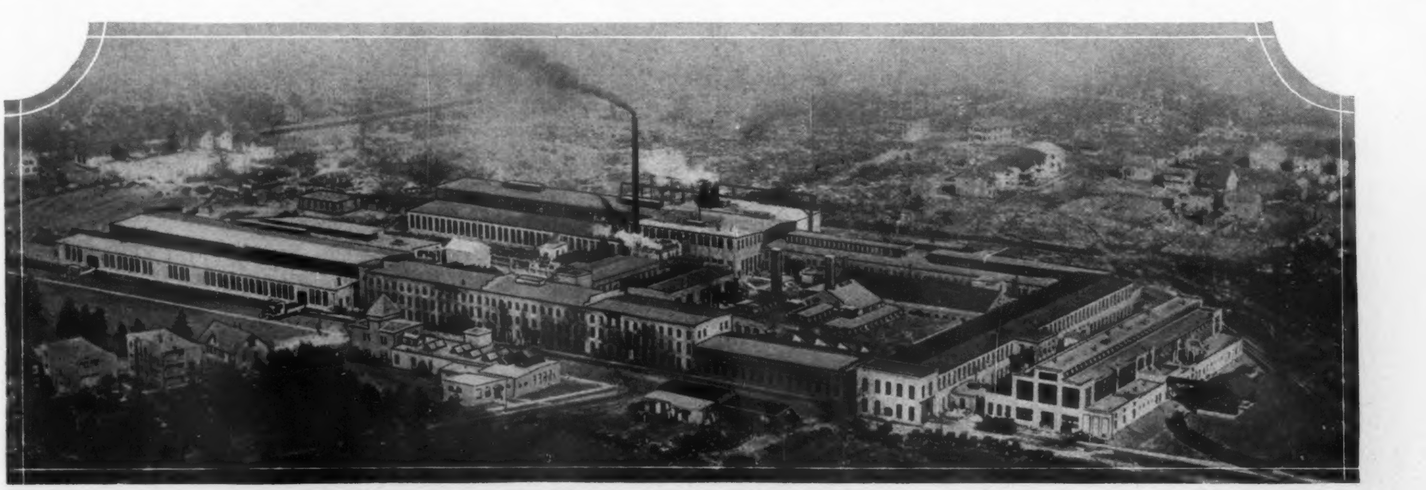
The industrial record of Indian Orchard—now a part of Springfield, is inseparably identified with the industrial annals of Springfield, itself. Industry, in the sense of manufacturing, owed its beginning in Springfield to George Washington who selected that town in 1789 as a place in which to establish a Government gun factory. Prior to that time, Springfield, although settled for more than 150 years, was little more than a village identified with the farming life which occupied the attention of the people of the neighboring section of the Connecticut Valley.

The creation of the Springfield Armory, as the Government gun factory was named, marked a significant turn in the industrial tide of the community. The armory brought there and developed there a body of highly skilled workers, as was to be expected in a plant devoted to turning out a precision product such as the military rifle which has made the armory world famous. Inevitably, other manufacturers were attracted to the city; and thus, decade by decade, was developed an industrial center noted for the mechanical expertness of its workers. So much for the background and for some of the reasons which induced the Chapman Valve Company—as the firm was then known—to move its place of business from Boston to Indian Orchard in 1874.

At that time, the company had been established for only four years, and was making a patented valve invented by one John A. Chapman. On petition of some of the original associates the Chapman Valve Company was dissolved in 1874, and a new corporation, called The Chapman Valve Manufacturing Company, was organized. The coming of the company to Indian Orchard was a boon to that village, because it brought to the town a mechanical industry which would give employment to men whose women relatives were mostly engaged in work in near-by textile mills.

The building of the Chapman shops was begun in 1874, but it was not until two years later that the plant, fully equipped, was in full swing on a producing scale. At that time, the foundry and the machine shop had a total floor area of 18,550 square feet; and manufacturing began with 64 patterns, that covered valves for handling gas, water, steam, and molasses, together with certain patents covering valves and core-box tubes. In those days, the working force was made up of 70 employees. Today, the plant has a total floor space of 365,427 square feet, and carries on its payroll 1,100 persons.

Much of the success of the company is due to the fact that it has kept pace with the march of mechanical progress and has never hesitated to adopt promptly new facilities whenever those facilities could be used to advantage. It is therefore understandable why a visitor to the plant should find it typically modern and efficient in every one of its departments. For instance, the steel foundry is entirely electrified and is equipped with electric furnaces for melting the steel. A furnace will handle 3 tons at a melt—representing a 100 per cent. overload, and will give 5 heats in the course of an 8-hour day. Cores are dried in electric ovens, and castings are annealed in ovens that are electrically heated. There are in the brass foundry 4 electric furnaces with capacities ranging from 250 to 800 pounds at a single melt. In the iron foundry, the metal is melted in one cupola which can produce in the course of a day a



Plant at Indian Orchard of The Chapman Valve Manufacturing Company.



Pneumatic chipping hammers and air-driven grinders are used extensively in the foundries to chip and to clean castings.

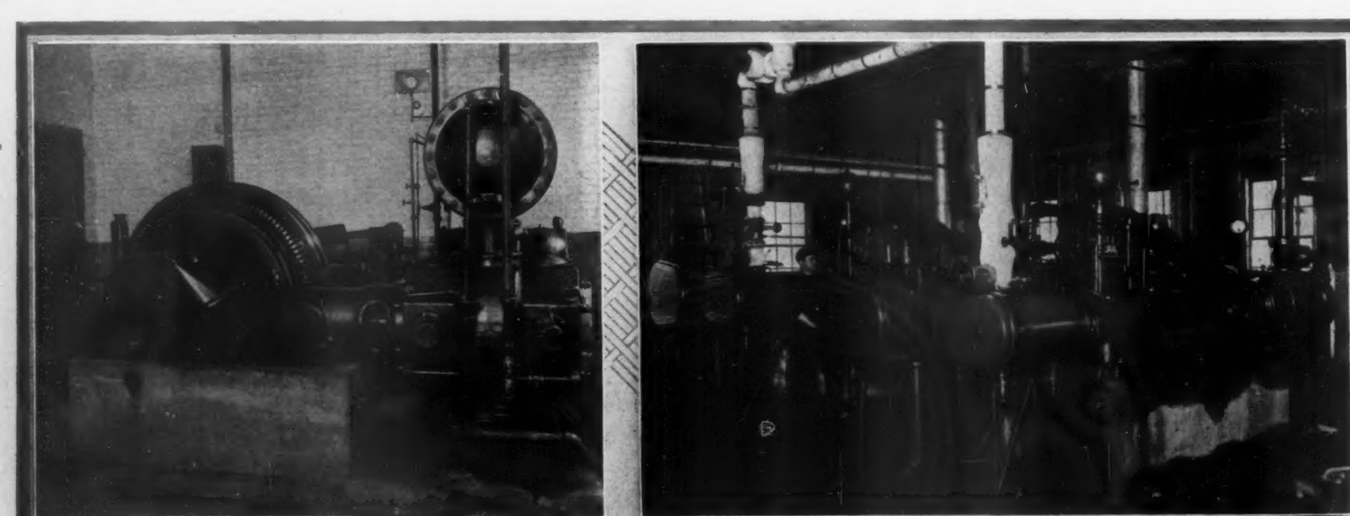
maximum of 50 tons of molten iron. It is not uncommon to find castings in the iron foundry that weigh as much as 10 tons each, while castings weighing 3,000 pounds are frequently made in the steel foundry. It is no exaggeration to say that a very considerable degree of the productive efficiency of the plant is directly attributable to the wide use of compressed air for many purposes. We shall describe some of these uses of compressed air later on.

During a recent visit to the Indian Orchard plant, it was made clear that nowhere within the Chapman organization is anything left to chance. To promote precision or certainty in production, the company has called into being a thoroughly equipped, modern, metallurgical laboratory that is administered by a full-time staff. The metallurgists examine all materials before they are used for manufacturing purposes, and this is a primary guaranty that the materials will measure up to specified requirements. The laboratory staff controls the melting of metals in the three foundries; and in the steel foundry the metal from each heat is tested in the laboratory before it is poured into the molds. By reason of the precautionary steps taken by the metallurgists it is possible for the factory to keep continually abreast of engineering progress and to make high-pressure steel valves that are being used in steadily increasing quantities in the power plants of the country.

Not a single valve, no matter whether it be small or large, is permitted to leave the plant before it has been subjected to tests which will prove conclusively that the valve is equal to the service conditions to which it will be exposed. This means that the valves are tested with compressed air, with water, and with steam agreeably to their prospective fields of application. Some of the steel valves are subjected to a test pressure of 1,600 pounds, while valves that are used in oil-well-drilling equipment may undergo a continuous 24-hour test at a pressure of 2,500 pounds.

Two of our illustrations indicate the extremes in sizes of valves produced at Indian Orchard. One is a picture of a ¼-inch lever valve and the other is a photograph of one of five valves, each of which had a waterway 9 feet in diameter. These giant valves were made for a power plant at Niagara Falls, and each valve was 30 feet 3 inches in height and weighed 130,000 pounds.

We need not enumerate the number and the kinds of valves manufactured at Indian Orchard in a year in order to get an idea of the plant's activities—there is another way to do



Left—One of the two PRE-2 compressors which furnish air to the steel foundry and to a near-by shop. Right—The two XPV compressors which supply the air used in various ways throughout the remainder of the shops.

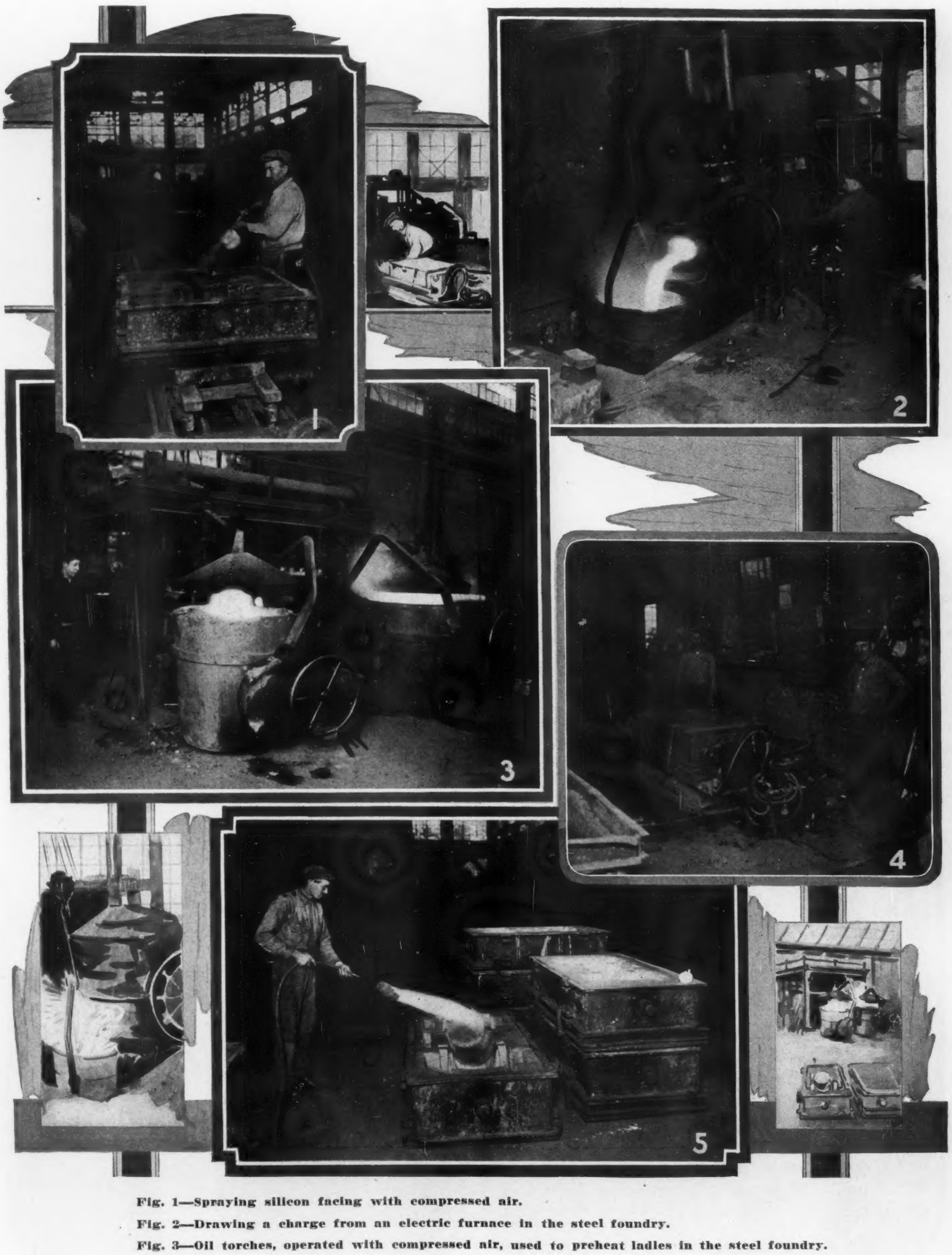


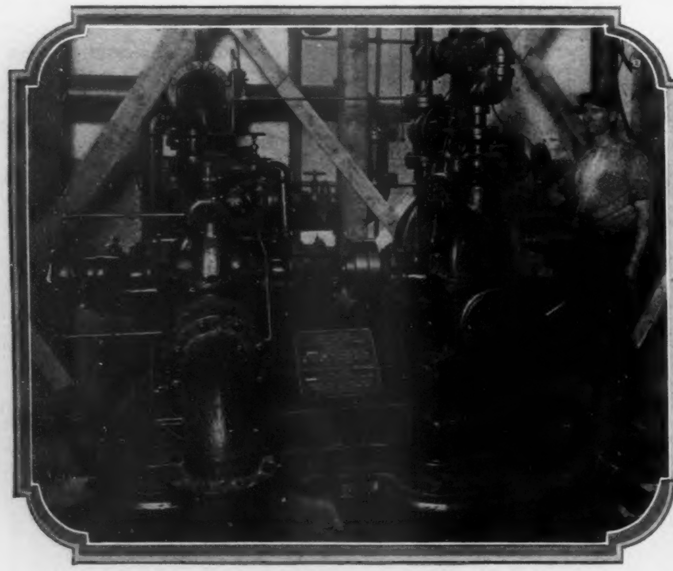
Fig. 1—Spraying silicon facing with compressed air.

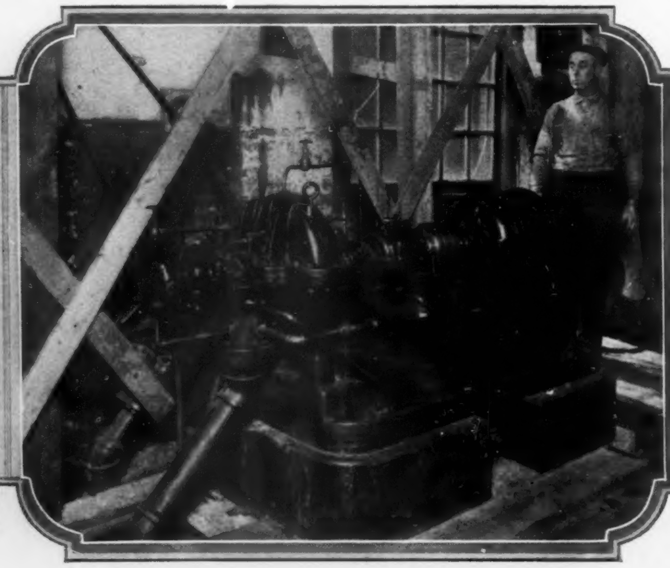
Fig. 2—Drawing a charge from an electric furnace in the steel foundry.

Fig. 3—Oil torches, operated with compressed air, used to preheat ladles in the steel foundry.

Fig. 4—Air-driven molding machine.

Fig. 5—Drying silicon facing with a kerosene torch using compressed air.





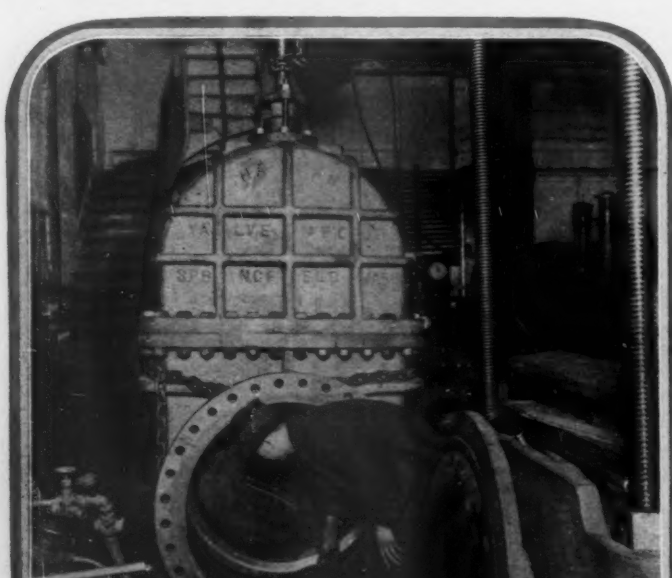
Left—Cameron pump of 1,000 gallons capacity driven by a Terry steam turbine. Right—Cameron pump of 250 gallons capacity directly connected to a General Electric motor. These pumps take care of the day and the night needs of the plant.

this. During a twelvemonth fully 600 cars laden variously with about 51,550,000 pounds of sand, pig iron, scrap iron, iron ore, scrap steel, copper, brass, tin, spelter, coal, coke, fire clay, lumber, etc., enter the plant. Aud during a like period there are shipped out of the plant 580 carloads of finished products having a total weight of substantially 20,416,000 pounds.

As might be expected, the up-to-date steel foundry makes use of air in a variety of ways to lighten labor, to insure first-class castings, and to give the castings a satisfactory finish. For instance, the molds are cleaned with compressed air; the silicon facing—so helpful in producing castings with smooth surfaces—is blown on the molds with compressed air; and compressed air directs the flame and gives the desired intensity to kerosene torches employed to dry the facing. The preheating of the ladles is done with air-operated torches. Air-driven sand rammers ram the sand in those molds that are not turned out with pneumatic molding machines, of which the foundry has a number.

After the steel castings are removed from the molds, they are largely freed of excess metal in the form of fins, sprues, gates, and risers by means of pneumatic chipping hammers and air-operated grinders. Finally, the castings are given their marketable surface finish by exposing them to a sand blast. To supply all the air needed in the steel foundry and in a nearby shop, there are installed adjacent to the foundry two electrically driven, direct-connected Ingersoll-Rand compressors, each of which is capable of furnishing the equivalent of 1,300 cubic feet of free air per minute. One of these machines has been in continuous service for more than three years; and because of the load on it the second compressor was purchased a few months ago. Speaking of the first unit, the engineer in charge remarked: "I challenge anyone to find a finer-performing machine." The air pressure throughout the line in the foundry is generally maintained at about 90 pounds.

Compressed air is used extensively in both the iron and the brass foundries where it performs services much like those done by it in the steel foundry. That is to say, the iron foundry is equipped with air-operated jarring and roll-over molding machines, and these machines are larger than those installed in the steel foundry. A very considerable part



Left—Making ready to test a large gate valve. Right—One of the numerous air hoists with which the plant is equipped.

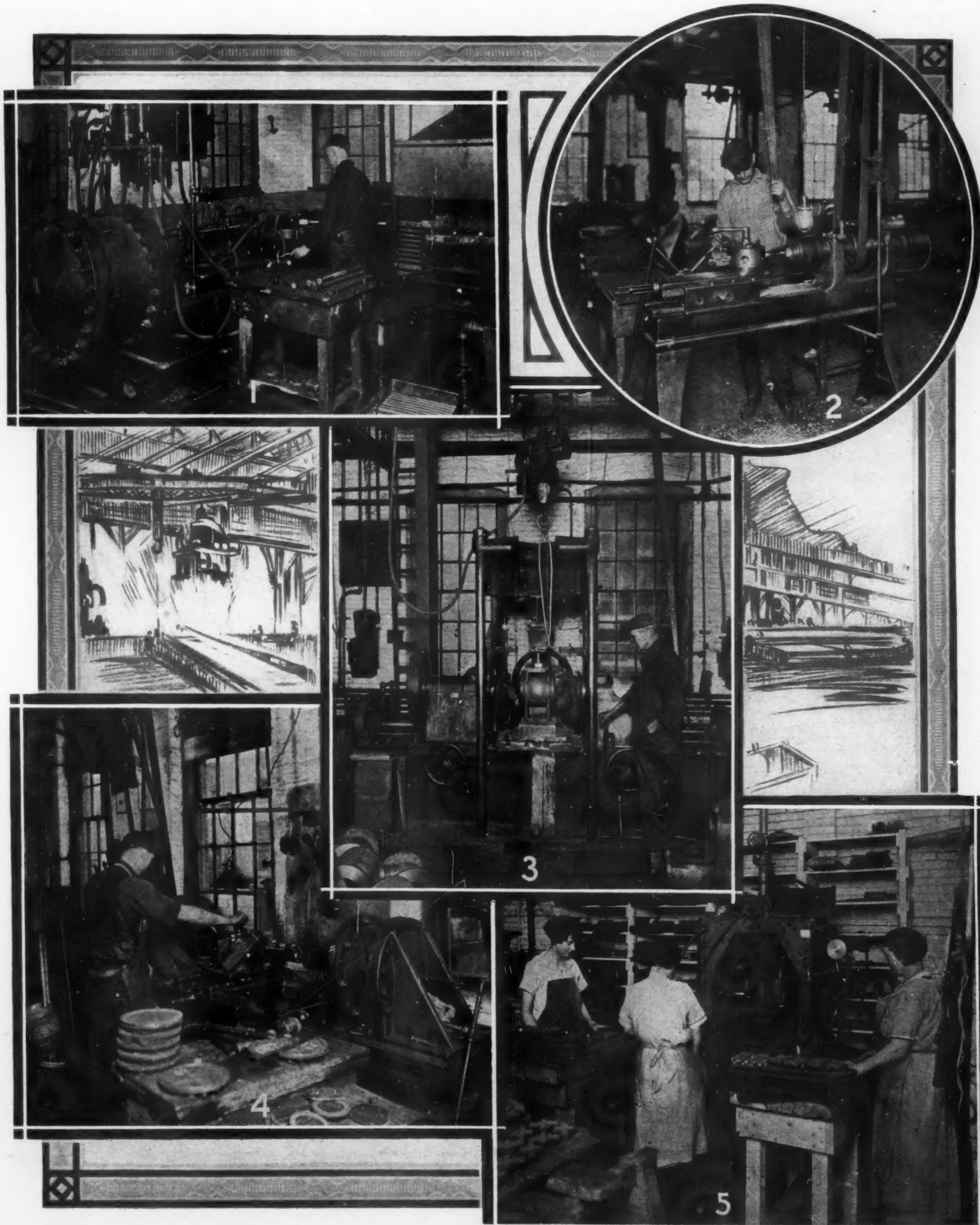


Fig. 1—Air-operated press which upsets brass and steel spindles after the bar stock has been heated electrically.

Fig. 2—Pneumatic chucks are extensively employed throughout the machine shops.

Fig. 3—Compressed air operates this rocker-arm press which holds valve castings in place while they are being machined.

Fig. 4—Air-operated plunger press which forces steel or bronze rings into steel valve plugs.

Fig. 5—Pneumatic core-making machine in which compressed air is applied directly to the sand.

of the work of the brass foundry is also handled by means of air-driven molding machines; and compressed air is used wherever it can help to save time and to insure a first-class product.

Compressed air is employed in a somewhat unusual way in the making of cores for small castings. For example, air pressure is applied directly to the sand to force the sand into core boxes; and the cores formed in this manner are more firmly compacted than is ordinarily the case when the core boxes are filled by other methods. Of course, one of the purposes in using a pneumatic core-making machine of this sort is to produce perfect cores rapidly.

Besides the electrically driven compressors already described, the plant of The Chapman

A giant gate valve with a waterway 9 feet in diameter.

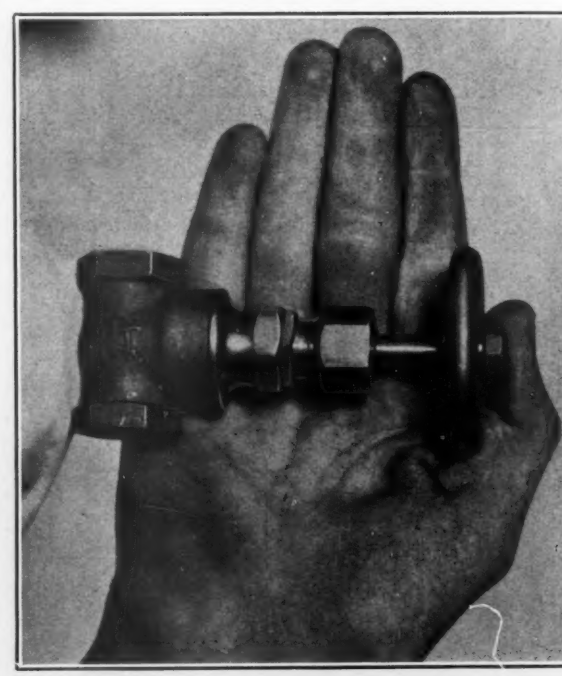
Valve Manufacturing Company is equipped with two older Ingersoll-Rand compressors of the XPV Type. These machines are steam driven, and each has a rated capacity of approximately 2,000 cubic feet of free air per minute. Much of the air furnished by these units is used throughout the machine shops, where it serves to operate various labor-lightening equipment and to drive the threescore and more air hoists with which the plant is provided. The machine shops of The Chapman Valve Manufacturing Company are unique by reason of their widespread employment of air hoists, which range in lifting capacity from 500 pounds to 4,000 pounds. These hoists have proved themselves peculiarly fitted for the work in hand, which calls for the frequent lifting and shifting of parts of many sizes and weights entering into the get-up of the different classes of valves made at Indian Orchard. The hoists are quick and positive in their action, and are admirably suited to the diversified demands made upon them.

Many of the lathes in the machine shops are equipped with air-operated chucks which save much time and greatly reduce the muscular tax upon the machinists. The chucks are of different sorts, and arranged so as to meet the special requirements of the jobs on which they are engaged. Compressed air serves to function a rocker-arm press which is used to hold valve castings in position while the valves are being faced simultaneously on three sides. The action of the press is such that it centers the casting on a supporting saddle and keeps it in proper alignment and position during the machining—thus relieving the machinist of much work and responsibility. The castings are lifted on and off the machine by an air hoist.

Compressed air is employed to operate a horizontal plunger press that has been devised to force brass or bronze rings into annular grooves cut in valve plugs. These rings take the rub which would otherwise come on the cast-steel part into which they are fitted. Another use of compressed air is in connection with an electro-pneumatic machine which upsets and forms the globular boss in the center of brass and steel valve spindles. The bar stock, especially of the larger sizes, is preheated in an oil-fired furnace and then set in the electro-pneumatic machine where the section to be upset is heated by an electric current of 20,000 amperes. As soon as the heating has reached the right point, the press is brought into play; and under an air impulse of 21 tons the bar is telescoped upon itself so as to form the boss where the electric current has made the metal suitably plastic.

Air-operated call whistles are in service throughout the entire plant; and the sprinkler system installed for fire protection works on the dry principle, that is, the line is kept continually charged with compressed air to hold back the water until a temperature is reached at any point high enough to melt the fuses and to release the air so that the water can flow to the sprinklers. Water for ordinary service throughout the plant and water for fire service are taken care of by two Cameron pumps. The regular service pump has a capacity of 1,000 gallons a minute at 2,300 revolutions, and this pump carries the day load and would be counted upon in case of fire. The smaller Cameron pump is driven by a directly connected motor, and is capable of delivering 250 gallons a minute at a head of 246 feet. This pump normally takes care of the night load, but could be used to supplement the larger turbine-driven pump for fire-fighting purposes.

In outlining the various uses to which compressed air is put in the shops and foundries we have touched only the high points in the applications of this handy medium. As a matter of fact, compressed air is utilized effectively and advantageously in numerous other ways. However, we are justified in mentioning that air-operated paving breakers, etc., are employed continually in plant maintenance work involving the cutting through of walls, in digging trenches, etc., required in making changes or alterations which are incidental to the up-keep of any alert and large manufacturing establishment.



One of the smallest products: a ¼-inch lever valve.

MAGNET REMOVES ROADWAY MENACES TO TIRES

MOTORISTS will be interested in what has recently been done out West in an effort to prevent the needless puncturing of tires. *Roads and Streets* informs us that a magnet, mounted on a motor truck, has been successfully used to pick up metallic tire-puncturing material of one sort or another from much-traveled roadways. On a 5-mile stretch from the Bunker Hill Smelter to Pine Creek, Idaho, the magnet collected 150 pounds of nails, bolts, wire, and scrap iron, while in three trips over another section as much as 603 pounds of nails, etc., was picked up. Most of this material was so small that it could not be seen in passing

The lifting magnet is suspended from the rear end of a 5-ton truck; and the lower face of the magnet is about 4 inches above the surface of the road. Electric current is supplied the magnet by 72 cells of a standard type of locomotive battery.

Gigantic Gas Holder of a Unique Type

By JOHN WALKER HARRINGTON

THERE is a strange structure standing near the Passaic River at Harrison, N. J., that looks not unlike a Chinese pagoda. It might even pass as a lighthouse, or a silo tank, or a grain elevator; but, in reality, it is something new in gas holders—a waterless gas holder that, for the time being, belongs to a class apart as once did the horseless carriage. The tank has a capacity of 15,000,000 cubic feet of gas, and is the largest of its kind east of the Rocky Mountains. A similar holder, of like capacity, has been erected in Los Angeles, Calif.

Ever since gas lighting was introduced, about a century ago, water has been considered a necessary feature of gas holders. Most of us can recall our school chemistry experiments in the vapor line. First, we up-ended a jar; poured in water to the brim; slipped a plate over it; and inverted it in a tub, also filled with water. Then we took the plate away; rested the vessel on a pair of bricks lying on the tub bottom; and under this improvised bell put a tube which was connected with a flask in which gas was being made. Bubbles rose and drove the column of liquid out of the jar; and, presto, we had a gas holder in miniature. Magnify this model many times into a cylinder of steel plates, curved and riveted, and you have the water-sealed holder now in common use.

The 15,000,000-cubic-foot gas holder when substantially completed. The size of the holder can be appreciated by comparing it with the near-by gas holder of the ordinary type.

Engineers, to cut down the costs of excavations and foundations, build this kind of container in sections, each smaller than the one beneath it, so that they can be telescoped. At the lower edge of each segment is a circular trough or cup filled with water drawn up from the lowermost tank. As gas is less than half as heavy as air the gas tends to buoy up the huge shell, which often has to be weighted in order to provide enough pressure to expel the product into the mains. As it rises or falls, the cylinder is kept in line by rollers or bearings which run up and down on the posts of an enclosing frame. This type of gas holder has given a good account of itself and is now in general use.

There were reasons, however, which caused the Public Service Electric & Gas Company to erect the waterless holder at Harrison. Despite the wide use of electricity for lighting, there is an increasing demand for gas in the factory and the kitchen. This especially applies to Newark, N. J., where the main office of the corporation is situated. That city is inhabited by nearly 500,000; but the total population served by that public utility numbers 2,300,000. These consumers live in 168 municipalities, covering an area of 100 miles long and anywhere from 4 to 30 miles wide and extend-

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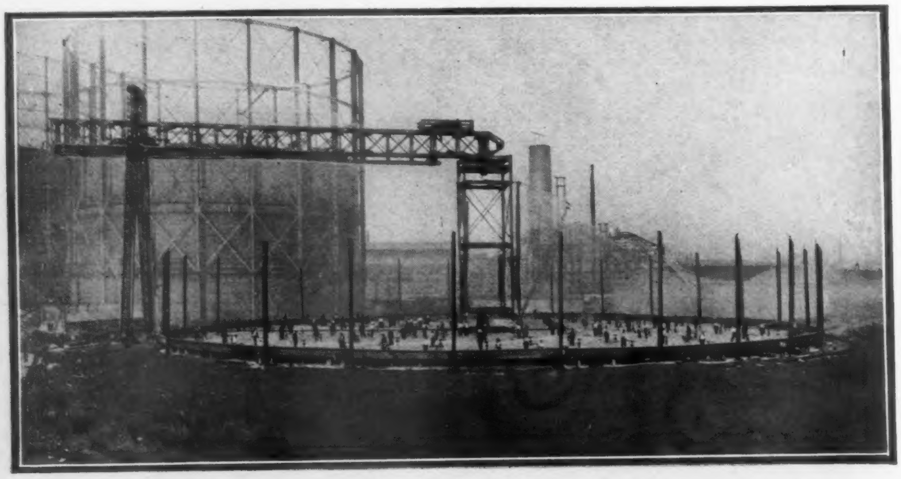
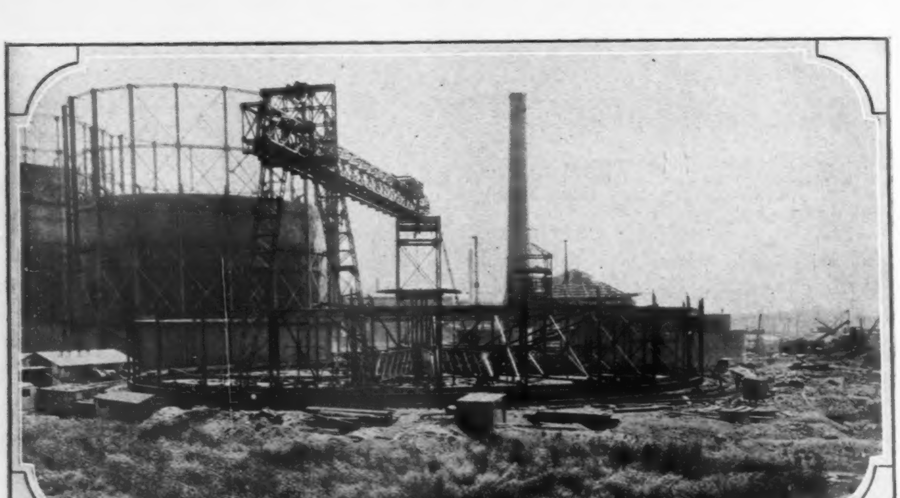
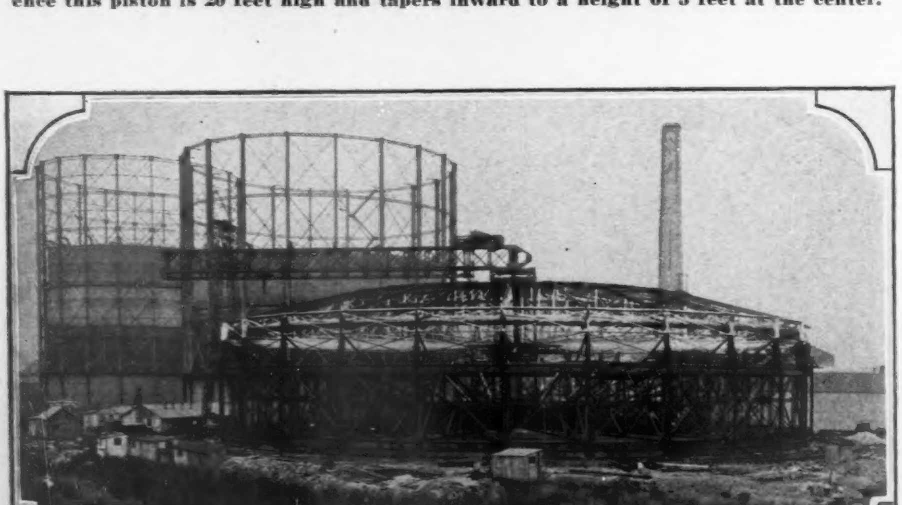
A glimpse of part of the densely populated territory which draws its gas from the mains of the Public Service Electric & Gas Company.



The base plate, 254 feet in diameter, forming the bottom of the waterless gas holder. This great disk, after it had been riveted together, was raised from the ground by the simultaneous movement of many hand-operated jacks.



After the completion of the base plate the next step consisted of constructing the piston which is an essential part of the waterless gas holder. At its circumference this piston is 20 feet high and tapers inward to a height of 5 feet at the center.



Stage by stage the completed piston was raised by means of compressed air, carrying aloft with it the roof which rested upon it. The piston was halted long enough at each stage upward to facilitate the assembling of the framework and the enveloping steel plating of the holder shell.

ing from Woodcliff, near the northern boundary of the state, to Woodbury, just below Camden. The heaviest demand for gas comes from the upper district, including the counties of Hudson, Bergen, Passaic, and a section of Morris.

To meet the requirements of the future, the Public Service Electric & Gas Company is building a new generating plant, at Harrison, with an initial daily capacity of 20,000,000 cubic feet of gas and an ultimate output of more than twice that amount. The company already had a 3,000,000- and a 5,000,000-cubic-foot holder there, but needed 15,000,000 more feet of storage space. The cost of erecting a water-seal holder would have been staggering, considering the masonry foundation, the excavation, and the land necessary for the purpose. Owing to the pressure of the water in both tank and lifts, and of the weight of the plates themselves, water-sealed holders are limited in height and must have wide bases. In winter, in order to prevent freezing, the contained fluid must be heated at great expense by steam or electricity. A peculiar electrolytic action, due to certain substances or gases held in aqueous solutions, often corrodes the steel plates—and that costs money. To overcome these disadvantages and to lessen expense, the company decided to build the new type of container.

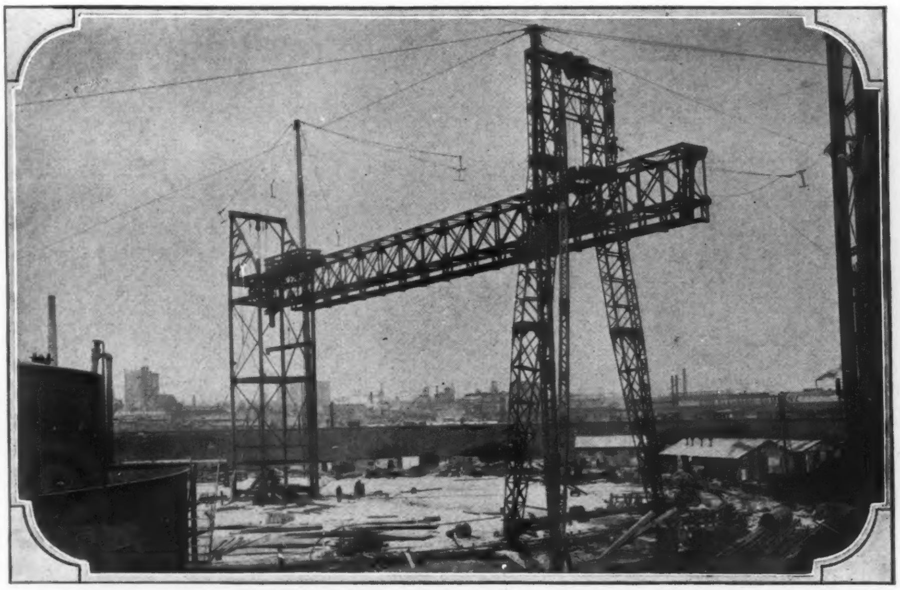
The first thing done by the Bartlett-Hayward Company, of Baltimore, builders of the holder, was to drive hundreds of wooden piles into the site. On this footing was placed a deep layer of reinforced concrete. Next came the 28-sided base plate composed of steel sheets assembled with the aid of air-driven riveters after the associate holes had been drilled and then reamed with pneumatic reamers.

Passengers, traveling in trains on the neighboring Pennsylvania Railroad, were astonished one day to see in progress at the gas works what seemed more like a moving-picture rehearsal than an engineering operation. In the center of the metal base plate and on a high platform stood the superintendent with a bell in his hand. Every time he rang, the mechanics all gave one turn to the jacks by which the disk was being raised.

On this floor, which is 254 feet in diameter, was built a piston of structural-steel trusses. This piston is 20 feet in height at the circumference and tapers down to 5 feet at the center. Around its rim is a flexible plate, edged with canvas, which is held firmly against the walls of the holder by counterweighted levers. The joint is made gastight by tar carried in a large groove or trough on the piston's outer edge. Any tar that seeps through runs down on the inner face of the walls of the holder and into a trench or sump, from which an automatic pump raises it and sends it back to the place whence it came. By reason of this closed circuit, but little of the tar or sealing fluid goes to waste.

As unique as the waterless holder, itself, is, the way in which it has been erected is equally unusual. On top of the ponderous piston, and before the first section of the walls was finished, was constructed a peaked roof. This

roof is made of steel plates, and is topped with a cupola. Skyscraper contractors think they have done something startling when they have put up the steel skeleton and roofed it over before the side walls are completed; but the Harrison holder had a roof before it had any columns to hold it up.

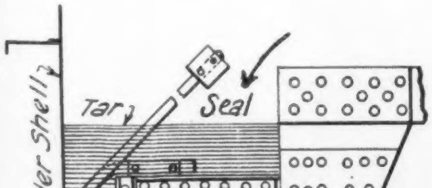


Great revolving traveling crane used in erecting the waterless gas holder at Harrison, N. J.

In building holders of this type, the contractor, after the piston and the roof are finished, constructs a small section of the shell. Then he forces compressed air under the piston—the air sending the piston and the roof up to the point where the wall ends. Then the piston is hooked temporarily onto the next tier of columns; more of the shell is built; and compressed air raises the roof another stage in its ascent. And so the work proceeds until the holder has reached the desired height. When the last plate of the shell is riveted in place, the roof beams are secured to the steel columns or piers. The well-packed piston is then ready for its trips up and down inside the tank.

The Harrison holder is 335 feet high; and, as a landmark, can be seen for miles. When Sir Walter Scott, more than a century ago, complained that a crazy Frenchman was proposing to light London with "smoke," Sir Humphrey Davy—upon being asked for his opinion—said that it was not feasible because it would be necessary, in order to store the needful gas, to have a holder or bell as big as the dome of St. Paul's Cathedral. That historic dome is 370 feet from the curb to the top of the cross, but its roof is only 300 feet above street level and the dome is only 125 feet in diameter. The new waterless gas holder has several times the capacity of the impossible container visualized by Sir Humphrey, and it will make the two water-sealed holders on the same lot look like pigmies.

Encircling the top of the structure is a row of windows, with panes of glass. This sun-parlor effect is not for ornament, but to facilitate the inspecting of the big chamber between the top of the piston and the roof. This work of inspection is a daylight job, for no matter how confident one may feel that everything is gastight one would hesitate to use a torch on such a trip of exploration.



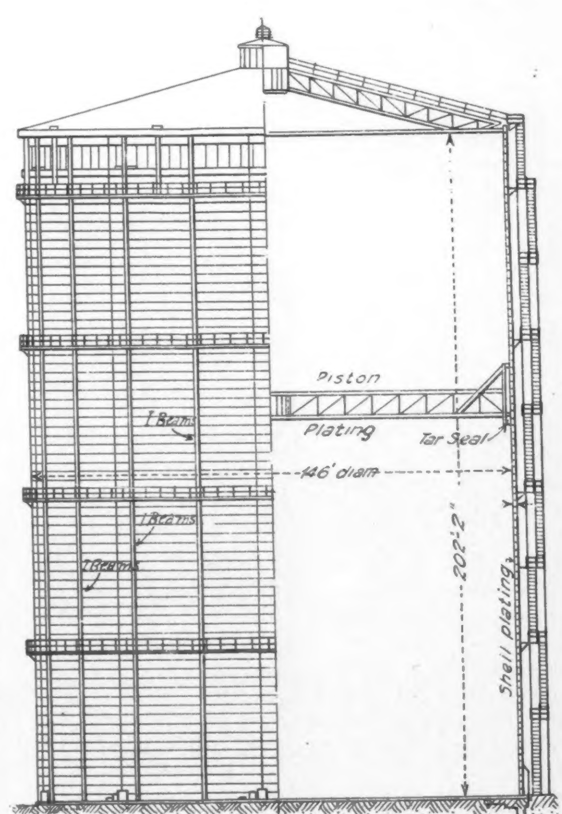
Cross section through the seal.

The position of the piston can be learned by a glance at an indicator, fixed on the outside of the tank, which records the changing height of the huge plunger as it moves up and down on its roller bearings. These bearings press against the inner faces of the columns supporting the walls. If the piston is forced too high there is a device to check it temporarily; and, if it persists in rising, a safety valve releases enough gas into the atmosphere to cause the piston to drop. Weights may be put on the top of the piston to restrain it and also to increase the pressure on the mains, for the gas in the holder has to be delivered throughout a wide area. Sometimes the pressure may be reinforced with pumps.

The inspectors who explore the upper region of the holder go up a ladder on the outside; enter the cupola; and then go down a ladder which touches the piston top. Inasmuch as the position of the piston is continually changing with the rise and fall of the contained volume of gas, this inner ladder is made with telescoping joints. It extends or collapses, according to the movement of the piston. It might well be called an "accommodation ladder," for it certainly does accommodate itself to circumstances. So much for the principal features of this largest of waterless gas holders which has 1,500,000 rivets in its get-up. A large force of boilermakers was employed on the job, and a battery of air-driven reamers and riveting hammers made it possible to speed up the assembling of the structural-steel parts.

But there is something else to be said in favor of the design, which is sufficiently flexible to permit the building of holders not only of different sizes but of different shapes. While the Harrison holder is 28-sided, the 50,000-cubic-foot tank at Somerville, N. J., is octagonal in form—in fact, it has been said that these structures may be given anywhere from 8 to 28 sides. There is an advantage in this. In certain neighborhoods, for example, where it is not desirable to mar the beauty of the scenery, the angles and the general character of the new type of holder lend themselves to a style of architecture that would be quite out of the question with the water-seal holder, with its uncompromising lines. The outer frame necessary in the case of the water-seal tank is done away with, as the waterless holder is strong enough to support itself and to withstand the stresses to which it might be subjected by high winds.

Porto Rico is becoming an increasingly important distributing center for the West Indies and the Caribbean trade.



Elevation and vertical section of the waterless gas holder.

Pneumatic Paving Breaker Drives Sheet Piling

By W. D. CHAMBERLAIN*

DURING April and May of the year just closed, the writer had occasion to drive 2x8-inch tongue-and-groove sheet piling in a trench for the Market Street Railway Company, San Francisco, Calif.

The length of the tongue-and-grove planks varied from 8 feet to 14 feet, and the trench was from 7 feet to 12 feet deep in sand saturated with water which necessitated the use of tongue-and-groove piling. Sheet piling of this sort gets thoroughly soaked when in water and swells considerably so that it is unusually hard to drive when down in the sand from 10 to 12 feet.

Pneumatic paving breaker proves very efficient and economical in the rapid driving of tongue-and-groove sheet piling.

At first, the customary method of driving the piles with a wooden maul was employed, but it soon became evident that this procedure would be very slow and would be apt to damage the upper ends of the piles. The idea of using an air gun for this work appeared promising, so an air compressor and a 38-pound Ingersoll-Rand "Imperial" tie tamper was taken to the job. The result was encouraging, but not up to expectations because the driving speed was rather slow at the start and seemed likely to be still slower as the pile penetrated deeper into the sand.

Next, an Ingersoll-Rand paving breaker, weighing 65 pounds, was tried, and the performances were so satisfactory that it was decided to continue the work with that tool. However, it was immediately apparent that a satisfactory cap would have to be designed to protect the tops of the piles, as the effect of the repeated blows of the hammer was so severe that a 1¼-inch hole was driven through a ⅜-inch steel plate in about 7 minutes. This difficulty was overcome by providing a flat plate, ¾ inch thick, that was placed on the pile inside the cap to receive the blows from the hammer steel. Plates of this kind would break at the rate of about 3 a day; and it was, therefore, necessary to keep a supply of extra plates on hand. It is probable that the breakage could have been diminished to a large extent, if not eliminated, by using thicker plates of tougher metal. Notwithstanding the breakage the incidental expense was small, as the plates were made by shearing off ¾x2-inch bars.

The cap and the plate, Figs. 1 and 2, and the method of using them on a sheet pile, indicated by Fig. 3, are shown in detail by the accompanying sketches. Another tool, illustrated by Fig. 4, was occasionally employed instead of the cap on the piles at corners and on some special piles. This was a 1-inch plate with a handle and having a hole ¼ inch deep for the hammer steel. The tool was held in place on the pile by hand. The steel used in the paving breaker was the usual 1⅛-inch hexagonal hammer steel for cutting concrete—the point being cut off to make a flat end, as indicated by Fig. 5. It was found that the hammer steel would stay in place in the 1¼-inch hole in the cap and never gave any trouble by jumping out. All told, 750 piles were driven with the outfit described. The speed of the downward movement of the pile ranged from a few inches a minute to 2 or 3 feet a minute—the average being about 12 inches. Two men operated the tool, one man holding the cap while the other handled the paving breaker.

On one section of the job, 214 eight-foot piles and 133 twelve-foot piles were driven by two men in 44 hours—making a total of 2,870 linear feet of piling driven in sand, or an average of 8.2 feet per pile. With labor at 55 cents an hour and a charge of 50 cents an hour for the use of the equipment, the cost per foot of pile driven was $.0245, which was considerably cheaper than hand work with a maul.

The advantages of the paving-breaker method of driving piles, when compared with the maul method, are: greater economy; greater driving speed; no damage to sheet piling; easier on the men; and less danger to men working in a trench below the outfit.

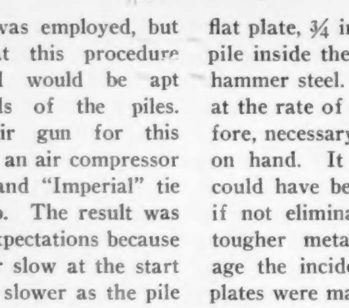


Fig. 1

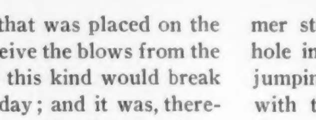


Fig. 2

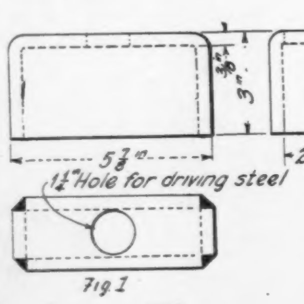


Fig. 3.

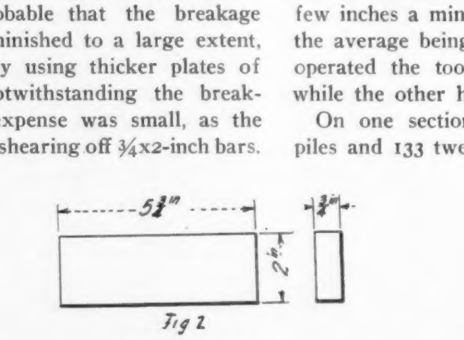


Fig. 4

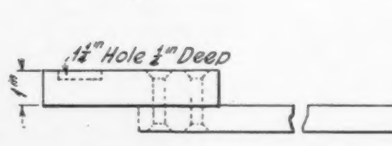


Fig. 5.

*Principal Assistant Engineer, Market Street Railway Company.

Historic Waterloo Bridge of London

How Traffic is Being Diverted Over a Temporary Steel Structure Until the Old Bridge is Repaired or Rebuilt

By WILLIAM D. SHAW

The wide span supported by four caissons has permitted shipping to proceed freely through the arches of the old bridge.

"NOBLEST bridge in the world, and well worth a trip from Rome to London to see." Thus, over a century ago, Canova—great Italian sculptor and friend of Napoleon — expressed himself about Waterloo Bridge. And speaking from an engineering standpoint, the celebrated French engineer Dupin remarked: "A colossal monument worthy of Sesostris and the Caesars!"

The bridge, with its approaches, has an overall length of 2,456 feet; cost $5,000,000; and took over five years to build. It was engineered by George Rennie, shipbuilder and son of James Watt's partner in steam-engine designing; and was first opened on June 18, 1817, the date of the second anniversary of the Battle of Waterloo.

Cornish granite was used for the arches and the exterior face, and the balustrade is of fine gray Aberdeen granite, magnificently tooled on the site by specialists imported from Aberdeen—somewhat of a journey from London in those days. The interior is of hard sandstone from Derbyshire and Yorkshire. The contractor for the granite, named Gray, was almost ruined by underestimating the cost of production of the required material—a calamity which would not have occurred had modern air-driven rock drills, drill-steel sharpeners, etc., been available instead of the tools of that period.

The elliptical arches over the river, of which there are 9, are 35 feet high, and each has a span of 120 feet. They are supported on piers which, with their abutments, rest on wooden platforms, which, in turn, are supported by piles driven 20 feet into the gravel of the river bed. The piers are 20 feet wide at the springing line of the arches.

Because the platforms lie in such a way as to be subjected to compression across the grain, these timbers have deteriorated, thus weakening the structure and inviting the danger of collapse after only 100 years of service. The fourth pier from the south side has shown signs of sinking for the past 50 years, but this movement has become more marked since about June of 1923.

Bridge engineers might do well to note this experience with the deterioration of timber caissons. The life of timbers compressed across the grain, as is the case in this instance, is about 100 years, whereas piles sunk by the Romans in such a way as to take the compression end-on—that is, along the grain, have been found to be in a good state of preservation after 1,800 years.

Quite apart from any structural weakness in the foundations, London bridges and buildings are subject to a vertical tidal movement caused by the elasticity of the underlying clay. Thus, when the tide goes out, the piers of the bridge rise one-eighth of an inch or more, and fall again with the incoming tide. A similar movement has been detected at St. Paul's Cathedral, which is some distance from the river bank. This famous and historic cathedral is now being renovated and strengthened, in which work compressed air is playing a helpful part.

Waterloo Bridge flanked by a temporary steel bridge over which traffic will move while the old structure is being repaired or rebuilt.

At the time of writing this article it has not been settled whether the old bridge is to be scrapped or whether it is to be rebuilt. In any case, a wider roadway is required to take care of the heavy traffic that crosses the Thames at this point. In the meantime, a temporary structural-steel bridge has been erected parallel with and close to the old span. This bridge is to serve during the five or ten years necessary to replace or to reconstruct the old structure.

The outstanding feature of the temporary

bridge is a large 500-ton span mounted on 4 steel caissons. In the riveting and the sinking of these caissons compressed air was used; and pneumatic drills were employed to do all the drilling in connection with the timberwork on the job. The smaller bridge spans are mounted on piles and girder structures. The caissons, each 12 feet in diameter, extend 24 feet below the river bed and are filled with concrete. The piers of the temporary bridge are in line with those of the old bridge so that the arches have in effect become tunnels. But by using a big double span between two pairs of caissons it has been possible to eliminate one pier near the Strand side and thus to assure a greater measure of safety for navigation.

Main span of temporary bridge. This picture was taken during the critical operation of launching the span from the old bridge onto the four supporting caissons.

This main span is 277 feet long. Notwithstanding its weight, it was erected on the old bridge and launched sidewise onto the caissons. It had to be moved laterally for a distance of 93 feet by means of hand winches and bogies, run out from the old bridge, and lowered 12 feet onto its bearings by four 200-ton hydraulic screw jacks. It is said that this is the heaviest span of its kind ever to have been launched by this method. As the load was little if any heavier than the normal tide of traffic borne by Waterloo Bridge it was possible to use that structure as a site on which to assemble the new span—thus saving time and money as well. The temporary bridge embodies more than 100,000 bolts and nuts. These were used instead of rivets to facilitate subsequent dismantling.

Waterloo Bridge has many historical associations. Right near the Strand end, at Wellington Street, is Somerset House, on the site of which was once a palace occupied by the wives of James I, Charles I, and Charles II, and where Queen Elizabeth lived before her accession to the throne. There, too, Oliver Cromwell's body lay in state in 1658. Beyond the south end of the span is London's largest terminal station, Waterloo Station, through which 25,000,000 fighting men passed during the World War.

Here we see how the temporary span was shifted laterally from the old bridge onto the caissons.

TESTS TO DETERMINE AGING PROPERTIES OF RUBBER

MOST persons have had more or less experience with the deterioration of rubber goods. For instance, a hot-water bottle may become hard and crack within a short time; a short circuit may occur in the vacuum-cleaner cord because the rubber insulation has become brittle and has broken; the garden hose may leak because of the failure of the rubber tube; or a pair of rubber gloves that have been stored for a while may be found worthless because the rubber has lost its life. Probably, it has also been observed that one rubber compound will last far better than another. While considerable experimental work has been carried on for the purpose of determining the aging properties of rubber, and while it is known that certain ingredients in rubber compounds or certain treatments yield either poor or good aging stocks, the fundamental causes of aging are not known.

Within the year just gone, the United States Bureau of Standards has started an extensive investigation of the subject with three objects in view: first, to determine the cause of the deterioration of rubber; second, to find means to prevent it; and, third, to devise laboratory tests by which the life of a rubber article can be predicted with more accuracy than is at present possible.

The work to date has been confined to 4 different rubber compounds, ranging from "pure gum" to a highly compounded stock containing reclaimed rubber. Each stock was vulcanized for 3 different periods, making a total of 12 different rubbers under investigation. The various factors which might affect rubber, including heat, light, oxygen, moisture, etc., have been isolated as far as possible, and the influence of each on the different rubbers is being determined.

The results to date show some very marked differences in the aging properties of the four compounds and in the ways in which they are affected by the treatments to which they are being subjected. Strange to say, the tests have so far brought out that the pure-gum compound has, as a whole, the poorest aging properties. Further, it has been found that the stock which is the most affected by heat is the least affected by light and, conversely, that the stock which is rapidly affected by light can better withstand heat.

Mechanical Classifying of Freight Cars

Electro-Pneumatic Systems Now in Use Greatly Reduce Hazards While Speeding Up This Essential Work

By THE STAFF

A Hannauer electro-pneumatic skate thrower which obviates risking life and limb.

QUICK and safe classification of freight cars, especially at large terminals, has been a problem engaging the attention of railroad men throughout the country for years. One student of the subject conceived an idea that, if properly developed, promised to relieve a situation that was becoming more and more troublesome with increasing traffic. That man was George Hannauer, vice-president of the Indiana Harbor Belt Railway; and his invention, fittingly called the Hannauer car retarder, not only simplified the handling of freight cars in the road's classification yard at Gibson, Ind., but also removed the element of danger. But before engaging in a description of the car retarder or taking up the subject of subsequent developments in electro-pneumatic rail brakes, let us picture two scenes.

In the first scene we see a string of freight cars, perhaps 60 or 70, slowly but gradually being pushed by a big locomotive up to what is called a "hump"—a hill rising abruptly to a height of 30 feet above the yard level. Stretched before us is a network of rails As the first car appears over the crest, a brakeman cuts it off from its fellows. On the down grade, the momentum of the uncoupled car increases; and it may or may not reach the particular track where the train, of which it is to become a part, is being made up. Sometimes the car rider, perched precariously at the hand brake, is unable to arrest its speed because the brake fails to respond, or through some other cause; and then, unless the switchman is right on the spot to send the car along the right track, it goes astray and may be brought to a sudden halt by smashing into another car. The runaway freight car may contain expensive glassware—the crash in that case occasioning a loss to the railroad company.

In the second scene, the string of freight cars looms over the hump in the selfsame way; but with the uncoupling of the car by the brakeman the similarity ceases. The car sweeps down the steep incline. Although there is no car rider at the brake wheel, a spirit of control seems to manifest itself as the car picks its way through the labyrinth of rails and finally reaches its destination some three miles away. To the uninitiated, there is something uncanny about the manner in which the riderless freight car invariably finds its way. The second scene exemplifies what has been made possible through the application of the Hannauer electro-pneumatic car retarder.

Ever since 1907, Mr. Hannauer persisted in the belief that the use of the hand brake could be eliminated in this work of freight-car classification if it were feasible to devise a pneumatic mechanism, secured to the tracks, that could be counted upon to grip the wheels of the cars in transit. After numerous failures—derailment proving the main stumbling block—his efforts were finally crowned with success. And right here it should be mentioned that credit is likewise due to Mr. E. M. Wilcox, master car builder at the Gibson yard, for the part he has played in the development of the car retarder. In Hannauer's earlier experiments he made use only of compressed air; but the system as now developed is electro-

Left—The car rider's job is a dangerous one at all times but especially so when everything is coated with ice.
Right—The yard man is throwing a "skate" by hand to arrest a car. This is a perilous performance and has caused many accidents.

Hannauer car retarder and a control cabin in the classification yard at Gibson, Ind.

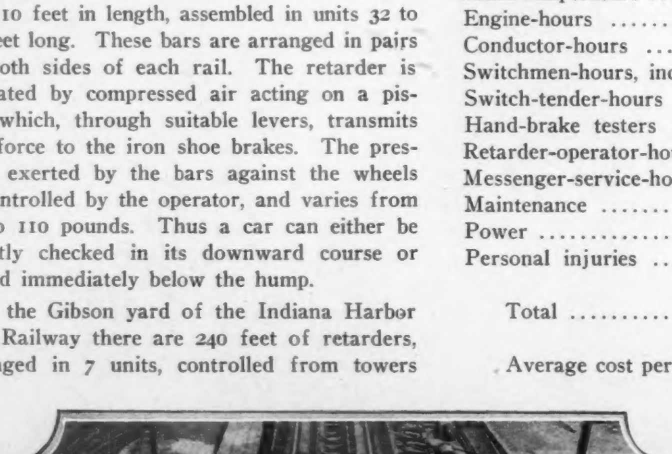
pneumatic, and this combination of forces makes for far greater ease of control and operating efficiency.

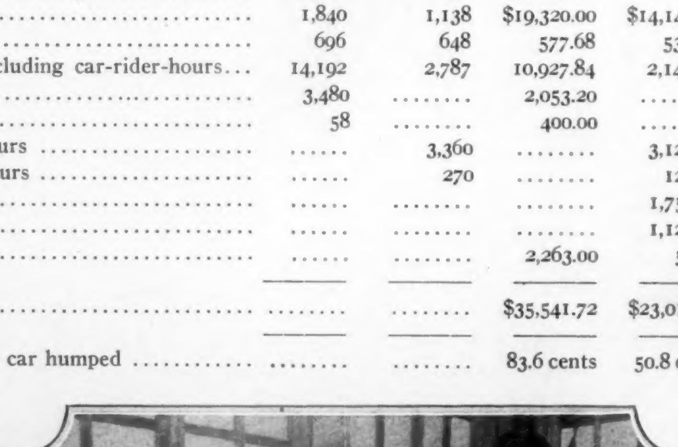
In effect, the car retarder is nothing more or less than the common air brake modified and attached to the track instead of to the car. It consists of a series of movable iron bars, each 8 to 10 feet in length, assembled in units 32 to 40 feet long. These bars are arranged in pairs on both sides of each rail. The retarder is operated by compressed air acting on a piston which, through suitable levers, transmits the force to the iron shoe brakes. The pressure exerted by the bars against the wheels is controlled by the operator, and varies from 20 to 110 pounds. Thus a car can either be slightly checked in its downward course or halted immediately below the hump.

At the Gibson yard of the Indiana Harbor Belt Railway there are 240 feet of retarders, arranged in 7 units, controlled from towers situated at strategic points in the classification yard. The regular switches are likewise operated from these towers. Besides the operators in the towers, the only other men required for the classifying of freight cars are the brakemen, who must cut off the cars as they come over the hump. In other words, compressed air and electricity are counted upon to do the work formerly done by the car riders, who had to guide the cars into place from their dangerous positions at the hand brakes on the roofs of the cars.

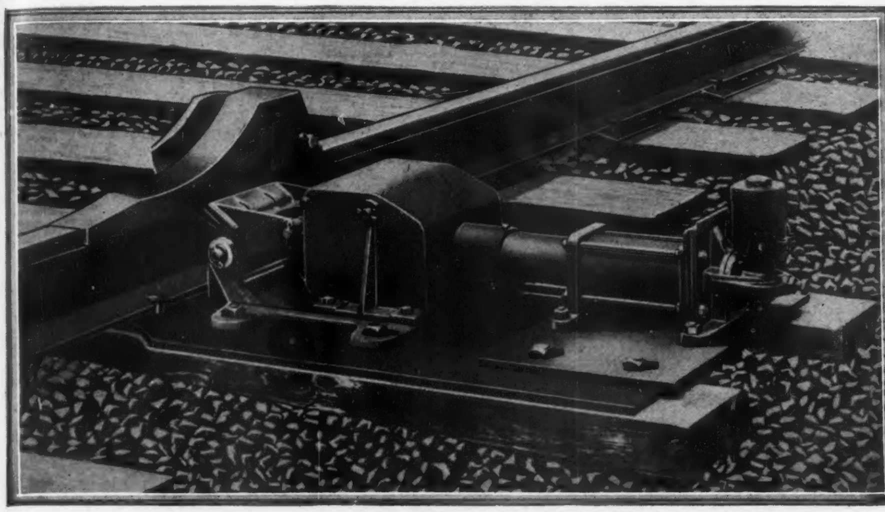
The winter of 1924-1925, especially the months of January and February, was severe enough to test the commercial practicability of the Hannauer electro-pneumatic car retarder. On several occasions the thermometer registered 20 degrees below zero Fahrenheit. Snowfalls exceeding 6 inches were not uncommon; and the ice at one time so thickly encrusted the freight-car couplings that mauls had to be used on them to carry on the work of classification. Yet, the retarder's usefulness was not interfered with; and the compressors were capable of supplying sufficient energy freely to move the levers at all times. Steam was used in the beginning of the winter to melt the snow from the several retarder units. But, after experimenting with compressed air, it was soon discovered that the air

	Quantities		Costs	
	Feb. 1924	Feb. 1925	Feb. 1924	Feb. 1925
Cars humped	42,534	45,283	....	....
Mean temperature	30°	30°	....	....
Engine-hours	1,840	1,138	$19,320.00	$14,149.00
Conductor-hours	696	648	577.68	537.84
Switchmen-hours, including car-rider-hours	14,192	2,787	10,927.84	2,145.99
Switch-tender-hours	3,480	....	2,053.20	....
Hand-brake testers	58	....	400.00	....
Retarder-operator-hours	......	3,360	....	3,124.80
Messenger-service-hours	......	270	....	122.50
Maintenance	......	....	....	1,758.05
Power	......	....	....	1,124.73
Personal injuries	......	....	2,263.00	55.25
Total	....	....	$35,541.72	$23,018.16
Average cost per car humped	....	....	83.6 cents	50.8 cents





Left—Track units of a Hannauer car-retarder installation. The brake shoes on each side of the running rail are actuated by electrically controlled air-brake cylinders; and, when closing in on the rail, the shoes grip the car wheels and arrest the car. Right—Interior of a Hannauer car-retarder control cabin. The various levers, viewed from left to right, operate skate throwers, switches, and car-retarder units.



An electro-pneumatic skate thrower devised by the Union Switch & Signal Company.

could dispose of the snow far more satisfactorily.

The great problem in all classification yards is to work to capacity during the periods of maximum demand. The peak traffic occurs in autumn and winter. Unfortunately, at those seasons it is hard to get car riders to take the added risks imposed by reason of ice and snow. By dispensing with his services, the Hannauer car retarder has made it possible to avoid danger to life while actually speeding up classification. The following figures will make this plain.

By the old method, on December 1, 1923, it required the services of 77 men to put 1,411 cars over the hump in 24 hours—averaging a car every 61 seconds or 18⅓ cars per man. With the car retarder operating at capacity, 10 men were able to put 1,042 cars over the hump in 8 hours—averaging 27 seconds per car, or 104 cars per man. This record was exceeded when 152 carloads of merchandise were classified by the aid of the car retarder in 52 minutes—a car every 20½ seconds. To those interested in statistics, the accompanying table, furnished by the Indiana Harbor Belt Railroad, may prove of interest as it shows, among other things, the difference in cost between cars classified by the old and by the new system.

Other factors that are contributing to the safe classifying of freight cars are pneumatic "skates" and switches. For the information of the uninitiated, a skate is a triangular piece of iron, with one side curved to fit the arc of the car wheel, that is designed to rest on the track. This contrivance had to be used with a fair measure of frequency at the Gibson yard in the old days to stop cars that had got beyond control in coming down the hump. In trying to place these skates on the rails in the face of oncoming runaway cars men were often seriously if not fatally injured. Nowadays, men are no longer called upon to jeopardize their lives in this fashion, as the skate, which is worked by compressed air, is controlled from the same station from which the retarder, itself, is controlled.

And now we come to a further improvement in electro-pneumatic retarders made by the Union Switch & Signal Company. This control is so constructed that as many as five different pressures can be applied to the operating cylinder. In this way, it is possible for the retarder to exert varying pressures and thus effectually to control cars of different weights and running at different speeds. The shifting of the control lever to any one of the contacts completes a circuit, thus energizing the corresponding control magnet and resulting in the admission of air to the operating cylinder. The piston, when thus forced outward, acts upon the retarder shoes, which are then in a position to exert the desired pressure against the car wheels. The pressure in the operating cylinder builds up almost instantaneously until it reaches the pressure corresponding to that called for by the position of the control lever. When that pressure is developed, the pressure-controller contact opens, and no more air is admitted to the operating cylinder. If the operator finds that he is not using sufficient pressure he simply moves the control lever to the contact corresponding to the next higher pressure. The aforementioned cycle is then immediately repeated, with the exception that the pressure is built up from the preceding pressure and not from zero, as was the case in the initial operation. The advantage of this system lies in the precision with which the desired pressure can promptly be applied.

As time goes on, other improvements will probably be made, and the splendid records already to the credit of the systems installed will be broken by still better performances. Be that as it may, in future, the name of Hannauer will invariably come to mind when car retarders are under discussion just as the name of Whitney is synonymous with the cotton gin and Bell with the telephone.

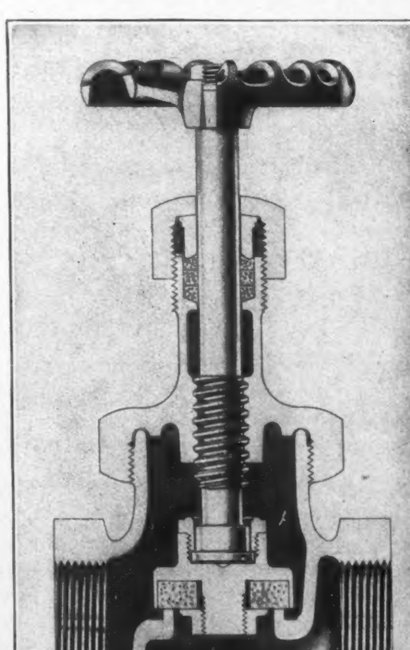
A moving sidewalk has been tried in a suburb of Paris with such satisfactory results that it is to be used in one of the principal thoroughfares of that city. Traffic is to be carried in both directions; and, for those who may prefer to walk, footpaths are to be provided alongside the moving sidewalks.

Scrap iron has become increasingly important in recent years in the making of steel, and it is now the general practice to utilize half scrap and half new pig iron for a charge. The sources of this scrap are as varied as the uses of iron and steel; but we are authoritatively informed that about 25 per cent. comes from the railroads, 40 per cent. from iron and steel works, and the remaining 35 per cent. from junk yards.

VALVES FOR MEDIUM AND HIGH PRESSURES

A LINE of medium-pressure, bronze globe and angle valves, for a working steam pressure of 225 pounds, has been designed to fill a need for a valve with a renewable disk that will satisfactorily meet pressures higher than those recommended for standard pattern valves. An important feature of these valves, placed on the market by Jenkins Brothers, is the 1-piece bonnet and union that is made to screw onto the outside of the body threads. It is claimed that this construction gives added strength to the body end—the bonnet hexagons being made especially large to allow for the removal of the bonnet without distortion. When the bonnet and body are screwed together, a strong "ball joint" is formed that cannot be readily broken.

These new valves are fitted for high-pressure work with a special composition disk that requires no regrinding to insure a tight valve. The manganese-bronze spindle has large, strong threads that are all in contact when the valve is closed. The stuffing box is deep, with plenty of asbestos packing that is compressed by means of a bronze follower. A ventilated hand wheel of malleable iron is used. The valves come with screwed or flanged ends, and range in sizes from ¼ inch to 3 inches.



Sectional view of globe valve.

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EDITORIALS

The Season's Greetings

AGAIN, we have the pleasure to wish you a Happy New Year and success in all your endeavors during 1926.

A year ago, in offering the season's greetings, we expressed a desire to add to the number of our readers in the course of the twelvemonth; and we now point with pardonable pride to a mailing list lengthened by fully 3,000 names during that period.

Naturally, we are highly gratified by this evidence of a widened field of service; but our greatest satisfaction lies in the fact that the added names represent just so many more friends. Our aim is to break this record in 1926.

QUARTERING THE CENTURIES

AS THESE lines come before the reader the first quarter of the Twentieth Century will have been completed and the second quarter begun. As we look back for a moment over the measured period, just gone into history, we are compelled to notice the crowding of events all through it and the change of outlook from the viewpoint we have reached. As we realize what has happened or, rather, what we have caused to happen; what has been done and what has been undone; how far we have advanced and how far behind us are many things but lately so familiar, we find that the retrospect is surely long enough and that an entire century is all too long for any immediately comprehensive view. Surely the centuries themselves have grown, as this first quarter of the new one shows.

The greatest war in all history has been fought to a decisive finish. Our ideas of government and of national life are being transformed. Kings are going out of fashion, and the apprenticeship of a new type of rulers has begun with new tasks to be fulfilled. These are the things the professional historian chiefly notes. The real "makings" of history are apparently but little related to these, yet they are the things that shape our lives and coming events.

Entirely within the present quarter-century has man mastered the art of flying. We are no longer confined to the surface of the earth. Undreamed of altitudes and speeds of flight are at once at our command, and so completely that we have not yet acquired the habit of using the facilities offered nor have we learned their limitations. The horse has been superseded as well as the bird; and all that that draft animal could do is now done many times over with vastly less human effort and care.

The fish we have also successfully challenged with the submarine. Most marvelous of all—and ultimately doubtless most valuable of all, most promising in its potentialities—are the means of communicating over the continents and across the seas without a visible link. Words and sounds of every character are broadcasted into space, and whosoever will may pick them up. The host of minor wonders that these years have brought out are too numerous to recite.

Our modern centuries, as we set out to suggest, carry too much—and increasingly so—to be encompassed within a single view. It would seem to be more convenient and effective to make the groupings smaller so that they may be considered in some detail. The time which passes in our growth from infancy to full maturity is a very fitting unit of time, a historical milestone, by which to measure or note our progress in life's journey. This the quarter century quite closely represents. Incidentally, just six of these periods comprise the record of our national life.

TEN MILLION MORE FOR THE SMITHSONIAN

THANKS to the bounty of an Englishman, JAMES SMITHSON, a fund of more than half a million dollars was bequeathed to the United States for the establishment of an institution to be devoted to increasing and to diffusing knowledge among men. In accordance with that bequest, The Smithsonian Institution was founded in 1846.

In the years that have intervened, The Smithsonian, as it is popularly known, has gone forward diligently and brilliantly in carrying on the work for which it was called into being. Not only have the scientists of the institution done their work well but they have laid the foundations for certain independent and allied undertakings that have proved of inestimable benefit to the American people as well as to the world at large.

It may not be a matter of general knowledge, but the United States Weather Bureau, the United States Bureau of Fisheries, the United States Geological Survey, the United States National Museum, and the Bureau of American Ethnology all had their inception in pioneer work done by members of the staff of The Smithsonian. These things have been accomplished through an endowment which brings in an annual income of only $65,000; and it is now imperative that that income shall be so increased that the funds available shall be commensurate with the scientific potentialities of the institute. To this end, the Board of Regents has decided to ask for gifts that will swell the endowment fund by $10,000,000. In view of what has been done and what is being done by The Smithsonian, it is earnestly urged that the appeal shall be promptly and generously answered by the people of the United States.

RAILROADS SAFER THAN MOTOR CARS

RAILROADING—once a very hazardous business—has become one of the safest of our activities so far as it concerns the well-being of its employees and the public. But what the railroads have achieved in the way of accident prevention has been woefully offset by the operation of motor cars and motor trucks.

We are authoritatively informed that 22,000 persons were killed by motor vehicles during 1925, and that thousands more were maimed or injured. The deplorable part of this record is that 90 per cent. of the casualties are avoidable. Fully half of the grim toll is among children. Surely something can be done to lessen this peril to the public. Effective ways should be found to reward the careful driver and, at the same time, to fittingly punish the heedless or the deliberately careless driver. Furthermore, careless pedestrians should be penalized.

Motor vehicles have come to stay and to perform helpful and even indispensable services, and one and all of us must accommodate ourselves to this newer order of traffic and subscribe to rules and regulations designed to make for the common safety.

THE ILLIMITABLE ETHER HAS LIMITATIONS

FIVE years ago, radio telephony was principally the hobby of a comparatively few people more or less of a scientific turn; and the companies fostering that fad did an annual business amounting to something less than $6,000,000. During the year just closed, radio manufacturers sold substantially 3,000,000 receiving sets and 20,000,000 tubes. All told, radio equipment bought in this country during the past twelvemonth has represented an outlay of fully $500,000,000!

This amazing development of an industry has brought us face to face with a curious situation—that is, the fact is forced upon us that the theoretically boundless ether has very decided limitations when it comes to the broadcasting of radio waves. Curiously, the

airways are now so crowded that any further use of the ambient ether is likely to bring about intense confusion. To some extent, this congestion may properly be attributed to the state of the art, and, in time, it may be overcome by technical developments which will increase the selective refinement of receiving sets. Be this as it may, it is undeniably true that the wave-length lanes now available are being utilized to the limits of their present effective capacities, and something must be done to check further crowding which might easily wreck an industry and rob the public of a source of pleasure and deprive it of a veritable boon.

AMERICA NEEDS MORE AND CHEAPER RUBBER

EVEN though we have many raw materials in abundance, still we are mainly dependent upon British plantations for the crude rubber which we work up into a diversity of more or less essential commodities. This situation would be serious enough if we used less rubber; but inasmuch as we consume 70-odd per cent of all the rubber marketed our predicament is intensified with each increase in price of the raw commodity. It is a matter of common knowledge that the price of raw rubber in the course of a few months has been forced from thirty cents a pound to upward of one dollar a pound; and the resultant gain to the foreigners dominating the rubber-growing industry comes out of our pocketbooks and especially out of the purses of motor-car or motor-truck owners.

It should, therefore, occasion no surprise that alert American interests are now bent upon establishing plantations in Africa, in the Philippines, and in Mexico from which we may draw in the near future enough crude rubber to meet in large measure our needs in this particular. The wonder is that we have so long neglected our own interests and have allowed ourselves to become wholly dependent upon the enterprise of foreigners that not unnaturally are now bent upon making us pay dearly for our lack of foresight. There is no physical reason why we should not establish rubber plantations in favorable climates and where native labor will make it possible for us to cultivate the trees and to harvest the sap under profitable conditions.

Mr. Terrence Parker, Ingersoll-Rand representative at Rio de Janeiro since 1911, succumbed recently to an operation while on a visit to the United States. Mr. Parker, for many years prior to his work in South America, was supervising and erecting engineer for the company at their London office.

When the work of enlarging the Welland Ship Canal is completed, the canal will have lock chambers 820 feet long, and will have a channel deep enough to accommodate vessels of 15,000 tons capacity. Canada has already spent $50,000,000 on this waterway, and it is estimated that before the work is finished in 1929 another $50,000,000 will have been expended.

THE PRESENT ECONOMIC REVOLUTION IN THE UNITED STATES, by Thomas Nixon Carver, Professor of Political Economy, Harvard University. A work of 270 pages, published by Little, Brown, and Company, Boston. Price, $2.50.

PROFESSOR Carver makes the point that there has been already accomplished in part in the United States an economic revolution of which the people at large are quite unaware. This revolution, as he sees it, is a beneficial one that has brought about economic changes that bid fair to make for better general understanding and less social unrest in the years to come.

According to Professor Carver, the economic revolution now well under way bids fair to wipe out the distinction between laborers and capitalists. Instead of fighting capital, labor organizations in the United States are using capital for their own advancement. The facts concerning this new labor activity are brought out by the author with startling clearness. His analysis of the labor situation in this country offers a possible solution of one of our most difficult social problems and gives us warrant for the belief that a sympathetic understanding is measurably nearer than ever has been the case before.

PLANTS AND MAN, by F. O. Bower, Sc.D., LL.D., F.R.S., Emeritus Professor of Botany, University of Glasgow. A copiously illustrated work of 365 pages, published by The Macmillan Company, New York City. Price, $4.25.

IN a lucid and entertaining way, Professor Bower explains how plants fabricate for their own life commodities that man finds so useful in his life, and the author gives a bird's-eye view of the far-reaching processes involved.

With most of us, our knowledge of botany is elementary and the result of what we learned in our early school days. There was much we did not learn then, and Professor Bower has taken pains to supply the deficiency and to tell us things that are well calculated to entertain the maturer mind of man who, in the last analysis, owes so much of his creature comfort to what plants provide. We heartily commend this book to those that would like to be better informed in this field of human knowledge.

STEAM CONDENSING PLANT, by James Sim, B.Sc., Eng. A copiously illustrated volume of 271 pages, published by D. Van Nostrand Company, New York City. Price, $6.50.

IN modern steam power plants, the condensing plant is so closely allied to the evaporator, the feed heater, the de-aerator, and the feed system that, to give the book some degree of completeness, the author has included a chapter on each of the associate units. This should make the work of value not only to students seeking information about rational methods to be employed in the designing of steam condensing plants, but it should also be a help to engineers engaged in either designing or operating such plants. The practical value of the book has undoubtedly been enhanced by introducing definite experimental coefficients and constants in the various formulae.

CHEMISTRY IN INDUSTRY, edited by H. E. Howe, Editor, Industrial and Engineering Chemistry. An illustrated volume of 392 pages, published by The Chemical Foundation, Inc., New York City. Price, $1.00.

WE had the pleasure previously to review Volume I of *Chemistry in Industry,* and in the present work, Volume II, the associate authors have given us a further exposition of the things done by the chemist as well as of the parts played by chemistry in modern life. The man in the street—that is, the average person, might well spend the time necessary to read through the two fascinating and informative volumes that the Foundation has prepared and placed at the disposal of the public.

Chemistry touches us at well-nigh every turn of our daily lives; and many of the things that we accept as commonplace accomplishments of industry are based upon really wonder-working achievements of the rather modest man of the laboratory. It is not possible to review the present volume in its entirety because of the variety of topic matter dealt with therein, but we can give a hint of the wealth of the contents by citing the titles of some of the chapters: *The chemical rainbow; Chemistry and its application to the confectionery industry; The chemistry of inks; Chemistry in refrigeration; Soap—cleanliness through chemistry; The relation of chemistry to water supplies; Chemistry, radio, and incandescent lamps;* and *Glues and gelatins.*

THE MINER'S FREEDOM, by Carter Goodrich, Assistant Professor of Economics in the University of Michigan. An illustrated book of 189 pages, published by Marshall Jones Company, Boston. Price, $2.00.

THE book is intended to show the effects on the working life of the individual miner of the inevitable extension of machine processes in the mining industry. We are told that the onward march of the application of machinery is rapidly changing the rough and arduous but surprisingly free and easy conditions of underground work. The individual miner is, so it is declared, becoming less and less his own boss; and the coal industry is in the initial stage of an industrial revolution akin to that which has long since taken place in the factory and in the machine shop. Professor Goodrich wrote the present volume after an extensive and somewhat protracted investigation in the coal fields.

Around the World with Texaco, by Charles Stuart Dennison, is the title of a series of articles, gathered in one volume, which first appeared in 1924 in *The Texaco Star.* Mr. Dennison went abroad to become acquainted with advertising and marketing conditions in various foreign countries in which The Texas Company does business; but he had an eye for local color, and his articles are therefore of general interest. The book, published by The Texas Company, New York City, is for free distribution.

Properties of steel filler rods for gas and electric welding is the title of a booklet issued by the Chicago Steel & Wire Company, Chicago, Ill. The booklet contains information which should prove of interest to users of gas and electric welding apparatus.

The California Highway Commission has recently published a *Manual of instructions of the Bridge Department*. The volume is really a guide to road and bridge builders, and embodies the ripe experience of the highway authorities of California.

The Austin Book of Buildings is the title of a handsomely illustrated catalogue issued by The Austin Company, Cleveland, O. The booklet contains much in the way of useful information in the field of business and industrial structures.

Maxim Industrial Silencers is the title of a pamphlet recently issued by The Maxim Silencer Company, Hartford, Conn. The booklet describes how silencers can be used to quiet gas-flow noises at exhausts and inlets; and includes other information having to do with the theories of sound and their relation to gas flow.

THE United States Bureau of Mines has announced the following list of new publications:

BULLETIN 234. *Screen sizing of coal, ores, and other minerals*, by E. A. Holbrook and Thomas Fraser. 1925. 140 pp., 23 pls., 22 figs.

BULLETIN 235. *Mine timber: Its selection, storage, treatment, and utilization*, by R. R. Horner and H. E. Tufft. 1925. 118 pp., 17 pls., 3 figs.

TECHNICAL PAPER 330. *Small hose streams for fighting mine fires*, by L. D. Tracy and R. W. Hendricks. 1925. 23 pp., 5 pls., 9 figs.

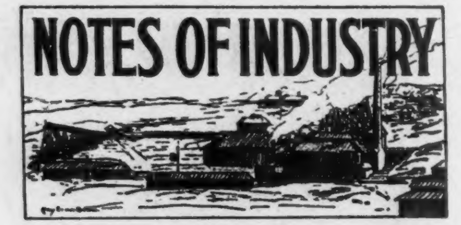
TECHNICAL PAPER 373. *The pyrotannic-acid method for the quantitative determination of carbon monoxide in blood and in air*, by R. R. Sayers and W. P. Yant. 1925. 18 pp., 2 pls., 1 fig.

TECHNICAL PAPER 376. *Permissible explosives, mining equipment, and rescue apparatus approved prior to January* 1, 1925, by J. E. Crawshaw, L. C. Ilsley, D. J. Parker, and A. C. Fieldner. 1925. 35 pp., 1 fig.

TECHNICAL PAPER, 380. *Production of explosives in the United States during the calendar year* 1924, by W. W. Adams. 1925. 35 pp., 1 fig.

Applications for publications should be ordered by number and title and should be addressed to the Director of the Bureau of Mines, Washington, D. C.

WEATHER forecasts, as pointed out by the Department of Agriculture, are of considerable value in large quarry operations in determining the most favorable time for blasting. Rain before a blast makes it difficult to finish loading for a shot, while rain or snow soon after a shot prevents the ground under the shot from drying so that the men are compelled to work in the mud.



As an inducement to foreign representation at the second sample fair to be held at Havana, Cuba, in February, 1926, steamship companies have decided to allow a 25 per cent. reduction in freight rates on merchandise to be exhibited at the fair. Cuban railways have granted a reduction of 50 per cent. in passenger as well as freight rates. The passenger rate applies only to merchants whose products will be on display and to probable customers who meet the requirements of the executive committee.

There is to be constructed on Seton Lake, about 135 miles north of Vancouver, what will be one of the largest hydro-electric power plants on the North American continent. The plan is, within the next five years, to spend $13,000,000 in the development of the first unit, which will make 60,000 H.P. available.

Between 25,000 and 30,000 tons of scrap iron and steel accumulate in Cuba every twelvemonth, and most of this scrap is sold to the United States. Among others, the Cuban railroads produce about 9,000 tons and each sugar central anywhere from 20 to 50 tons per annum.

During 1924, the latest statistics available, 3,640,108 passenger cars and trucks were manufactured in American factories, as against an estimated output of only 330,000 automotive vehicles for the leading European producing nations of Great Britain, France, Italy, and Germany.

Merchandise worth $300,000,000 are in transit daily on the railroads of the United States.

The development of the American-Australian trade during the past 30 years is of interest in view of Australia's great distance from the United States. American exports to Australia, which were valued at less than $9,000,000 in 1895, rose steadily to $43,350,000 by 1913 and to more than $125,000,000 by 1924.

Leading motor-car manufacturers emphatically advise automobile owners to use distilled glycerine as an anti-freeze solution in the radiators of their machines. Distilled glycerine does not affect the finish of a car; and as no glycerine is lost through evaporation the first cost is the only cost

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The present annual steel-ingot production in the United States is just short of 60,000,000 gross tons, which is considerably more than the output of the rest of the world, while the pig-iron capacity of the country is now rated at 53,000,000 tons—being more than half of the world's total output of this commodity.

According to the latest statistics compiled by the Bureau of Public Roads, the mileage of surfaced roads in the United States is approaching the 500,000 mark. To be exact, there were 467,905 miles of surfaced roads in the country at the end of 1924. In this connection, it is interesting to note that one of the subjects to be discussed at the American Road Builders' Association, to be held in Chicago in January, is a proposed new national highway system. This highway would be made up of a network of 50,000 miles of improved roads connecting all the states and the larger cities, and would be marked and maintained by the states.

The United States Department of Commerce recommends the creation of a national commission whose purpose will be to make a study of the most effective utilization of our forest products. This is heartening news, in view of the manner in which our forests have been devastated in the past.

It is interesting to note that while the production in American industries has increased 185 per cent. within the last 25 years, the number of wage earners has increased only 90 per cent. in the same interval.

Naples has the distinction of being the first city in Italy to build and to operate a subway. The line was opened to traffic at the end of 1925.

VEHICULAR TUNNEL UNDER THE MERSEY RIVER

A road tunnel, to connect Liverpool and Birkenhead, England, is to be constructed under the River Mersey at a cost of £5,000,000. Work on the project is to commence at an early date. The point chosen for the passageway is at the narrowest part of the river; and the outlets are so planned—two on the Liverpool side and one on the Birkenhead side—that no congestion in entering or leaving shall result. The tunnel will permit two lines of traffic to move in each direction, and will have a capacity of 2,000 vehicles an hour. Gradients will be 1 in 30 for slow-moving or heavy vehicles and 1 in 20 for fast or light traffic.

The tube will be of cast iron; and the space between the tube and the sandstone rock is to be completely grouted with a cement or a lime mixture applied under pressure. This mixture will be forced in a semifluid condition through holes in the castings, which will be sealed subsequently with screw plugs. The tunnel is to have an internal diameter of 44 feet, allowing for a roadway 36 feet wide between curbs and a narrow foot path on each side. The sectional areas not required for traffic are to serve as inlets for fresh air and for exhausting the vitiated atmosphere—thus avoiding the use of air at high velocity for the ventilating of the tunnel. The air will be fed under the roadway and pass up and out through exhausts overhead.

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